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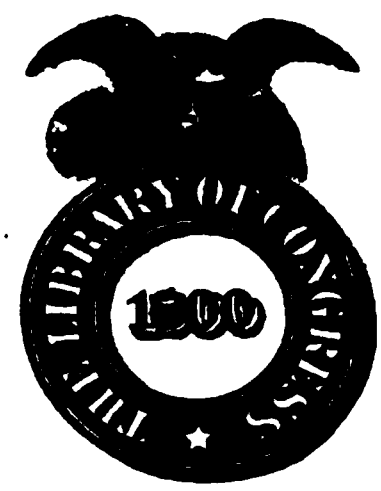
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REPORT

OF THE

SIONER OF AGRICULTURE.

1885.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1885.

JOINT RESOLUTION to authorize the printing of 310,000 copies of the Annual Report of the Commissioner of Agriculture for the year 1885.

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That there be printed 310,000 copies of the Annual Report of the Commissioner of Agriculture for the year 1885: 200,000 copies for the use of the members of the House of Representatives, 80,000 for the use of the members of the Senate, and 30,000 copies for the use of the Department of Agriculture, the illustrations for the same to be executed, under the supervision of the Public Printer, in accordance with directions of the Joint Committee on Printing, and subject to the approval of the Commissioner of Agriculture.

SEC. 2. That the sum of $2,000, or so much thereof as may be necessary, is hereby appropriated out of any money in the Treasury not otherwise appropriated, to defray the cost of the publication of said report.

Approved March 3, 1885.

TABLE OF CONTENTS.

	Page.
rt of the Commissioner	5
rt of the Superintendent of Garden and Grounds	33
rt of the Chief of the Seed Division	47
rt of the Botanist	63
rt of the Microscopist	89
rt of the Chemist	109
rt of Chief of Division of Forestry	183
rt of the Entomologist	207
t of the Statistician	345
t of the Chief of the Bureau of Animal Industry	431
t culture in India: By Rev. I. L. Hauser	569
farming: By A. Oemler	583

LIST OF ILLUSTRATIONS.

P

REPORT OF THE BOTANIST:
1. Jeffersonia diphylla (Rheumatism root) .....
2. Ilex cassine (Yaupon) .....
3. Rhamnus Purshianus (Cascara Sagrada) .....
4. Cassia Marilandica (Wild Suma) .....
5. Gillenia trifoliata (Indian Physic) .....
6. Hamamelis Virginica (Witch Hazel) .....
7. Liquidamber styraciflua (Sweet Gum) .....
8. Grindelia robusta (Gum plant) .....
9. Eriodictyon glutinosum (Yerba Santa) .....
10. Euphorbia corollata (Wild Ipecac) .....
11. Euphorbia Ipecacuanha (Wild Ipecac) .....
12. Aristolochia Serpentaria (Virginia Snake root) .....
13. Asarum Canadense (Wild Ginger) .....
14. Anemopsis Californica (Yerba Mansa) .....
15. Arisæma triphylla (Indian Turnip) .....
16. Symplocarpus fœtidus (Skunk Cabbage) .....
17. Black rot of the Grape .....
18. Smut of Timothy (Tilletia striæformis) .....

REPORT OF THE MICROSCOPIST:
Cut—Fibers, chemical action on .....
Cut—Parasitic mites found in domestic fowls .....
Plate I—Crystals, butter, and fats .....
Plate II—Edible mushrooms .....

REPORT OF THE FORESTRY DIVISION:
1. Diagram showing percentage of forests, farms, unimproved and waste lands in the United States .....
2. Diagram showing the proportion of forests, farms, unimproved and waste lands in the United States in 1885 .....
3. Diagram showing the extent of loss by forest fires in one year .....

REPORT OF THE ENTOMOLOGIST:
Plate I—The Periodical Cicada, eleven figures .....
Plate II—Silk-worm diseases, four figures .....
Plate III—Silk-worm diseases, two figures .....
Plate IV—Silk culture, egg production, four figures .....
Plate V—The Periodical Cicada, four figures .....
Plate VI—Miscellaneous .....
Fig. 1—Periodical Cicada .....
Fig. 2—Dermestes vulpinus .....
Fig. 3—Eurycreon rantalis .....
Plate VII—Miscellaneous .....
Fig. 1—Agrotis messoria .....
Fig. 2—Diplosis nigra .....
Fig. 3—Diplosis nigra .....
Fig. 4—Diplosis nigra .....
Fig. 5—Anthonomus musculus .....
Fig. 6—Anthonomus musculus .....
Plate VIII—Destructive Locusts, seven figures .....
Plate IX—The White-Pine Weevil, five figures, all wood-cuts .....

REPORT OF THE STATISTICIAN:
Plate I—Price of beeves in Chicago .....
Plate II—Export of hog products .....
Plate III—Wheat production and export .....
Plate IV—Effect of quantity upon prices .....
Plate V—Exports and imports of agricultural products .....
Plate VI—Changes of wages of farm labor .....

BUREAU OF ANIMAL INDUSTRY:
Investigation of Swine Plague:
Plate I—Ulcerated cæcum in swine plague .....
Plate II—Swine plague and *Rouget* .....
Investigation of Southern Cattle Fever:
Map showing infected territory .....
Investigation of Verminous Bronchitis:
Plates III, IV, V, and VI .....

REPORT

OF

THE COMMISSIONER OF AGRICULTURE.

DEPARTMENT OF AGRICULTURE,
Washington, D. C., November 20, 1885.

To the PRESIDENT:

I have the honor to respectfully submit a report of the affairs and operations of the Department of Agriculture during the past year, which have been subject to my supervision since the 3d of April last.

This Department has in its charge the interests of an industrial class far more numerous than any other in the country. With a territory of such breadth, a climate so varied, a soil so generous; with a continuous stream of agricultural immigration pouring into our borders; with the constantly increasing advantages derivable from improved skill and ingenious labor-saving appliances, there is necessarily a corresponding enlargement of production. This renders necessary a wise distribution of crop areas, the introduction of new products, and an increased supply of those products which at present are notably insufficient to meet the growing demands of home consumption. One of the most important of these is sugar—an article of prime necessity. The development of an industry which combines agriculture and manufacture is slow and difficult; yet the progress made in the Department's experiments during the past season, as gauged by actual results, looking to the increased production of sugar within our own borders, is more positive and satisfactory than hitherto, and promises ultimately the highest success.

There are fibers whose production can unquestionably be made profitable in this country, and whose utilization only awaits successful invention and manufacture. There are fruits and other edible products which should enter into the variety of our agricultural productions and re ources for meeting the demands of consumption.

been prolific of rural benefaction. Opening in gloom, ng t destruction of winter crops by severity of temperature, is bright with the cheer and blessings of abundance for man , produced at a cost which is not a burden to the producer, price which is not a barrier to the poor consumer. Though

the product of wheat is less than for many years, the supply from previous harvests is ample for domestic and probable foreign requirements.

The distinctively American product, maize, which dominates the tillage of North and South, and, next to grass, is the source of our meat production, is in larger supply than ever before; while cotton, the money crop of ten States, has only once or twice before been exceeded in quantity. The soil has yielded a generous return for the labors of the husbandman, and the prospect for the future is bright before him. It is gratifying to observe, as seasons pass and agricultural methods improve, that the soil ameliorations effected by drainage and greater thoroughness of cultivation are reducing the effect of adverse meteorological conditions of excessive moisture in spring, and drought in summer, equalizing the extreme results of good and bad seasons, and giving increased steadiness and certainty to the efforts of the farmer.

It is also gratifying to note that upon every hand can be found an increased interest of the farmer in his work. Local societies in the interest of agriculture are multiplying in number as well as augmenting in size; interest in discussions upon agricultural topics is everywhere increasing; and, indeed, upon all sides can be seen encouraging evidence of the desire on the part of the farmer for the latest information upon timely subjects, which shall enable him to cultivate the soil more intelligently and scientifically than those who have cultivated it before him, and which shall also enable him to leave it richer and more productive for those who are to follow him.

For many years it has become more and more apparent that one great need of the agricultural interests of the United States, is a better understanding and a more intimate relation between the several agricultural colleges and experiment stations, and a more practical co-operation between these institutions and the Department of Agriculture.

Among my first acts of administration, therefore, was the request of these institutions to send delegates to a convention to meet at this Department in the month of July last. The result of that meeting was most gratifying. All sections of the country were represented, and throughout its deliberations there was a manifest desire to co-operate with the Department in its efforts to develop systems which should better unify results of experiments and reports upon them.

These agricultural colleges were severally endowed by one and the same act of Congress. They are now separately carrying on experiments at an expense of time and means, and yet without any central head through which to report and compare results with each other.

United, these several State organizations, with their carefully tilled soil, their line of mechanical appliances, their scientific methods of cultivation, and their habits of observation of every stage of growth, could engage in the work of developing new systems of agriculture, the necessity for which is fast approaching; while in a divided condition, and without united purpose, work will be often duplicated, experiments will

be of local value only, and communities alone, instead of States, will have the benefit of the valuable results of science and practice.

No suitable provision, however, having been made by the National Government for any extended practical experiments in this direction, it is respectfully submitted that the Department should have full authority and ample means to avail itself of the peculiar advantages offered by these endowed institutions, in order to test, in a manner and on a scale sufficient to determine all questionable points, the adaptability of new and rare seeds to the various sections of our country. Surely the opportunity to use these fully-equipped experimental farms for the benefit of their respective localities and of the country at large should not be lost.

Believing that the Department of Agriculture can, if wisely conducted, become a vitalizing center for a more general co-operative effort for the promotion of agricultural science, and that the various State Experiment Stations should be encouraged by the most cordial co-operation on the part of this branch of the National Government, I have endeavored, with my very limited means and force, to organize a branch in this Department to take charge of the returns from these colleges and stations, and to collate and distribute the information obtained for the benefit of all interested parties.

I am happy to say that the institutions alluded to warmly approve of this plan, and are aiding me with their suggestions and co-operation.

The efforts which are hereafter to be made to carry out the unanimously expressed will of the convention on this subject deserve the careful consideration of Congress.

THE BUREAU OF ANIMAL INDUSTRY.

"An act for the establishment of a Bureau of Animal Industry, to prevent the importation of diseased cattle, and to provide means for the suppression and extirpation of pleuro-pneumonia and other contagious diseases among domestic animals" was approved May 29, 1884.

The objects and purposes of the Bureau are clearly defined in the above title of the act establishing it. At the time this act was passed by Congress it was not known that the disease called pleuro-pneumonia among cattle existed in any part of the United States west of the Alleghany Mountains, but in August, 1884, it was discovered in the State of Illinois, and an investigation by the officers of the Bureau revealed a very extensive and alarming outbreak, involving herds in Ohio, Illi- n and Kentucky. Such measures were adopted to prevent its fur- r spread and to secure its eventual extirpation as were possible t law and by co-operation with the authorities and citizens of the a ; States.

! aw (ablishing the Bureau of Animal Industry does not author- he sl h : of affected animals, but only authorizes such quaran- · necessary to prevent the spread of contagious diseases

from one State or Territory into another. It is consequently impossible for this Department to maintain an effectual quarantine under the present law. The disease is a peculiar one, in this, that in an affected herd there is, generally, a considerable proportion of the animals which are affected in so mild a form that their illness is not noticed, and yet they are capable of communicating the contagion to other herds.

Another class of affected animals are more severely attacked, but make a partial recovery, and although the trained veterinarian may be able to find signs of disease by an examination of the respiratory organs, people not skilled in such examinations can detect no signs of the plague. Unfortunately all animals once affected, whether the attack has been mild or severe, are dangerous for an indefinite period afterwards. These characteristics make the disease a very difficult one to extirpate, except by the slaughter of all sick animals, and either the slaughter or the quarantine of all that have been exposed. Such is now the policy and practice of most civilized nations.

To protect the great cattle interests of this country requires vigorous means and measures. The existence of pleuro-pneumonia and other contagious diseases has had a very serious effect upon our foreign and interstate commerce in living animals. Great Britain, on account of it, has placed such restrictions upon the trade that no cattle, sheep, or swine can be sent there from this country, except for immediate slaughter at the landing places. The effect of this is to prevent the exportation of any but fat cattle to that kingdom; and even these, it is estimated, do not bring as much within $10 or $15 a head, as they would sell for if they could be taken inland and held until they had recovered from the effects of their journey, and for a favorable state of the market. Since these restrictions have been enforced the exportation of sheep has steadily declined from 108,652 in 1879 to 32,510 in 1884, and that of swine from 25,033 in 1879 to 4 in 1884.

The restrictions upon our interstate commerce from the same cause have been a very great burden, and the reduction in the value of cattle in the affected States has been enormous.

The regulation of commerce with foreign nations and among the several States is placed by the Constitution under the exclusive control of Congress, and this regulation, it has been decided, includes such measures as are necessary to protect foreign and interstate commerce, to promote its growth, and to remove restrictions from it.

The traffic in live animals constitutes such an important part of the commerce of the country, and the capital invested in the flocks and herds from which this commerce is drawn represents so large a proportion of the wealth of the nation, that it has become very desirable, from a national point of view, that such regulations should be adopted as will insure the removal of these restrictions and do away with the cause which has led to them. It was to secure this result that the act establishing the Bureau was passed, but experience has shown that the

powers conferred by that act are not sufficient for the purpose. I would therefore recommend such additional legislation as may be necessary to make the work of the Bureau more effective.

The scientific investigations of the Bureau in regard to the nature of communicable diseases, and the means by which they may be prevented, have been carried on unremittingly during the year, and the results throw much light upon these obscure questions. These investigations will be published in detail in the annual report of the Bureau of Animal Industry, which is now in preparation.

In addition to the work referred to, this Bureau has made an investigation of the condition and number of the domestic animals in various parts of the country; of the peculiarities of the animal traffic, and of such changes in present methods as would be of advantage to those engaged in this industry. The report thereon will be published in detail.

July 1, 1884, the management of the quarantine stations for imported cattle was transferred from the Treasury Department to the Department of Agriculture, and has become a part of the duties of the Bureau of Animal Industry. Stations are maintained for the ports of Boston, New York, and Baltimore, and arrangements have recently been made by which animals arriving at San Francisco are also quarantined. The stations for the ports of Portland, Me., Philadelphia, Pa., and New Orleans, La., have been discontinued. There has been no request to be allowed to land cattle at Portland since the quarantine was transferred to this Department, and only two animals have passed through the station at New Orleans, both of which were landed at New York and could have been quarantined there.

DIVISION OF CHEMISTRY.

The importance of chemistry to agriculture was first recognized in the works of Liebig. Before his time little was known of the constitution of the soil, or of the nature of fertilizers. At the present day the usefulness of chemical science to agriculture is not questioned by any well-informed person.

The work of the division during the year may be classed under five heads, viz:

1. Analysis of soils.
2. Continuation of the investigations of cereals.
3. Experiments in the manufacture of sugar.
4. Investigation of food adulterations.
5. Miscellaneous.

ANALYSIS OF SOILS.

The object of undertaking this work was fourfold:

(1) To n e al of samples of soils from different parts of the , ich sent to the Department from time to time during y r and a half.

(2) To further investigate the problem of the chemical composition of a soil with reference to its fertility.

(3) To collect and compare the different methods in use for soil analysis with the design of unifying them as much as possible, in proposing a method which might seem best adapted to general use.

(4) To put in form for general use points in connection with soil analysis concerning which frequent inquiries are addressed to the Department, to answer which in detail would be quite impracticable.

The results of the work are now in manuscript and are ready for publication.

INVESTIGATION OF CEREALS.

The work of the division of chemistry during 1883 and 1884, in investigating the influence of climate and soil in the composition of cereals has been continued with good results. The cereals examined have been wheat, oats, and corn. One of the chief objects of research with wheat and oats has been to trace the effect of climate and soil on the albuminoids of grain. Those cereals are generally more highly valued as the percentage of the albuminous contents increases.

The size and weight of the grains have also been carefully determined. The investigations have now proceeded far enough to determine what parts of the country produce the best cereals, without respect, however, to the quantity produced.

The results of the work are being rapidly collated and will soon be ready for publication.

EXPERIMENTS IN THE MANUFACTURE OF SUGAR.

Sugar planters have long been aware that a large percentage of the sugar produced was lost either in milling or in the processes of manufacture. It is scarcely extravagant to say that during the last decade fully half of the sugar the soil has produced has been lost before the manufactured article has entered commerce. It was with the purpose of checking this waste that the Department undertook the experiments mentioned.

To avoid the loss in milling it was determined to try the process of diffusion. For this purpose apparatus was erected in Kansas for cutting sorghum cane into thin slices and extracting the sugar therefrom in a diffusion battery consisting of ten cells. The result of the experiment was highly gratifying. The degree of extraction was fully 98 per cent of the total sugars present. Mechanical difficulties in the form of the apparatus which could not have been foreseen interfered, somewhat, with the successful working of the process economically, but these difficulties readily overcome.

To avoid the loss incident to the usual process of manufacture, the process known in the beet sugar industry as carbonatation was tried and its results were entirely satisfactory.

To the juice as it comes from the mill, or the diffusion battery, a large excess of lime is added, and this is afterwards precipitated by blowing through the mixture a current of carbonic acid. The precipitate which falls, carries down with it nearly all the impurities of the juice and leaves them in a state suitable to easy separation by filtration. The use of this process entirely prevents the losses from scums, and affords a product in every way superior to that given by the old method.

It was the intention of the Department to make similar experiments in Louisiana, and preparations for them are nearly finished. But delay in getting a part of the apparatus and the improvements suggested by the experiments in Kansas, rendered it advisable to postpone the work for another year.

In view of the important results achieved by the experiments in Kansas under the direction of the chemist of this Department, I have thought it advisable to send him to Europe for the purpose, not only of more thoroughly familiarizing himself with the processes of diffusion and carbonatation, but also to examine machinery recently designed for cutting up cane, with a view to purchasing such apparatus as is necessary to carry the proposed experiments of another year to a successful termination.

FOOD ADULTERATION.

It is highly desirable that some general standard of purity for foods should be established and that uniform methods of examination for adulterations be agreed upon. As a beginning in this direction the Division of Chemistry has begun a series of investigations in food adulteration. The work already done has been chiefly with butter and honey, and the general results of the analyses tend to establish an average composition for each of these articles of food, which, when more definitely described, may serve as a standard of comparison. The work has further shown the character and extent of the adulterations.

The work with honey will soon be concluded, but with butter and other dairy products only a beginning has been made. It is proposed to extend this line of investigation until the ends sought for are attained.

MISCELLANEOUS.

In this category is to be placed a large amount of work done by the division which is so varied as to escape a more particular classification.

It includes many analyses of waters, assays of minerals, examination o s, phosphatic rocks, and artificial fertilizers, &c.

P aps the most important work of a miscellaneous nature was that in connection with the Association of Official Agricultural Chem- , whose labors have led to the adoption of uniform methods of sis for commercial fertilizers throughout the United States.

invi ion of the Department the last meeting of the association Washington, and action was taken relating to the enlarge-

ment of the scope of the work of the organization so as to bring it more in harmony with the investigations of the Department relating to the adulterations of foods.

For the coming year it is proposed to continue the work of investigating the adulteration of foods, the experiments in the manufacture of sugar, and the miscellaneous work.

ENTOMOLOGICAL DIVISION.

The importance of the study of economic entomology becomes every year more and more apparent. Scarcely an agricultural or horticultural meeting takes place but that the subject of injurious insects and the best means of counteracting their ravages occupy a large share of attention. The losses occasioned by destructive insects to the farmers of the country aggregate an enormous sum, and there are few directions in which the Department can do more good than in researches having for their object the prevention of a portion of these immense losses. The valuable results already obtained in the work of the Entomological Division under its present efficient management are a sufficient promise of good work yet to be done.

The work of this division has greatly increased during the year, several new lines of investigation which promise valuable results having been entered upon.

The appearance of the so-called "seventeen year locust" or periodical cicada, in May and June, over a large extent of country, enabled the Entomologist to make many interesting investigations in regard to it, and a bulletin (No. 8 of the present series) was prepared and issued, giving a full account of the habits and life-history of the species, and a revised edition is being prepared.

Two other bulletins have been issued, one (No. 5) treating of certain parasites of injurious insects, and the other (No. 6) of the imported elm-leaf beetle. This last is a practical treatise of an insect that has of late years proved very injurious to the elms throughout the Eastern States, and shows clearly and plainly how it may be satisfactorily dealt with.

Destructive grasshoppers have been exceptionally abundant during the summer. One species (*Melanoplus destructor*), peculiar to the Pacific slope, has done much damage in California, and special study has been given to it on the spot.

Remembering the fearful devastation caused by the Rocky Mountain species between 1873 and 1877, the people of the West have felt very keen anxiety as to the future on account of the increased injury the present year. The entomologist has given this subject very careful attention, and, from the reports of special agents and a full consideration of the subject, he concludes that there is some danger of increase in the next two or three years should the weather prove favorable to the insect. As an encouraging offset to this rather gloomy prospect, he also

considers that, under conditions the most favorable to grasshopper increase, the injury can never be as widespread as it has been in the past, owing to the advance and increase in settlement in the Northwest.

Other destructive insects have been very numerous, and a series of test experiments have been made by agents stationed in New Jersey, Indiana, and Iowa, with many insecticides which have been recommended but never thoroughly tested.

In response to an evident want a station has been established, in charge of a competent agent, at Aurora, Ill., for purposes of experiment in regard to apiculture. The objects are: To secure the introduction and domestication of such races of bees as are reported to possess desirable traits and characteristics; to prove by experiments their value to the agriculturist of the United States, and their adaptation to our climate and honey-producing flora; to make experiments in the crossing and mingling of races, and endeavor to secure the type or types best adapted to the uses of our bee-keepers; to make experiments in the methods of artificial fertilization; to test the various methods of preparing bees for winter; to study the true causes of diseases yet imperfectly understood, and the best methods of preventing or curing them, and to obtain facts as to the injury to fruit by bees.

Another new field of investigation has been added to the division by the appropriation by the last Congress of $5,000 to be devoted to the "promotion of economic ornithology, or to the study of the interrelation of birds and agriculture, an investigation of the food, habits, and migration of birds in relation to both insects and plants." I have commissioned Dr. C. Hart Merriam, the chairman of the committee on migration of the Ornithologists' Union, to act with the Entomologist in this matter, and circulars have been prepared and sent out, and the work is now progressing in such a way as to promise solid and valuable results.

The work of the division in relation to silk-culture has largely increased, and a corresponding addition has been made to the clerical force of the office. Silk-worm eggs have been distributed in response to a very large number of applications coming from all parts of the Union. Many have also been supplied with mulberry trees by co-operation with the Superintendent of Gardens and Grounds. Attention has been given to the establishment of a market for silk cocoons, with a view to overcoming the difficulties which have thus far been found to lie in the path of the silk-raiser in this direction. The cheapness of foreign labor comes more actively into competition with the industry of manufacturing raw silk from the cocoon than it does with the raising of the cocoon itself. In the former case, the workshops are open all the year round, giving

nt employment to their operatives, who must therefore look to this

for their livelihood; in the latter, there is only work enough

y t silk-raiser six weeks in the spring and early summer;

the industry therefore may be made one for the household, thus utilizing time that would otherwise be lost.

The filature problem, therefore, becomes the more difficult one to solve and has received much attention. In furthering the establishment of a cocoon market, and with a view to obtaining some reliable statistics of the expense of operating a filature in the United States, two stations have been opened, one at New Orleans, and the other at Philadelphia. At these points, in co-operation with private persons, I have been, since last spring, operating two small establishments, which have consumed several hundred pounds of cocoons raised in the United States. It was not to be expected that first-class raw silk would at first be produced. American silk-raisers are as yet too generally inexperienced to produce a first-class cocoon, which can only be looked for after several years of successful operation in the industry. A station has also been opened in California, a building suitable for making sericultural experiments having been constructed at Piedmont, in Alameda County. Here it is designed to experiment in co-operation with the State board of silk culture, and the Ladies' Silk Culture Society, at the same time using the institution as a sericultural school. The division will continue during the coming winter and spring to distribute silkworm eggs and manuals of instructions in silk-culture to all worthy applicants, and to take such other steps towards fostering the industry as circumstances may from time to time require.

DIVISION OF STATISTICS.

The branch of the Department service under the direction of the Statistician has met the public demand for co-ordinated fact and systematic statement, during the past year, in response to requests from heads of Departments, Senators and Members of the House, officials of foreign governments, boards of trade and chambers of commerce, agricultural and industrial societies, authors, editors, and others. The necessity for comprehensiveness and completeness in statistics, as well as accuracy, is more appreciated as popular intelligence advances and culture broadens.

The printed reports of the statistics of agriculture during the year include 708 pages of monthly issues, and 147 of the annual report, a total of 855 pages. The aim has been in these reports to give practical and useful information, plainly and concisely, avoiding as much as possible fragmentary and inconclusive statement.

The crop-reporting system, which has been in operation twenty years, and has been adopted by several States and by some European governments, consists of boards of observation and report in over eighteen hundred counties of the United States, comprising nearly all of the developed territory of the United States. A parallel or duplicate work, for the purpose of verification and for special local investigation, is carried on through State agents. The foreign work, under

the direction of an agent in London, who is connected officially with the Department of State, has been improving in efficiency and breadth during the past year. This was undertaken at the urgent request of representatives of western agriculture, to obtain advance information concerning European products with which ours come in direct competition. The need was emphasized by the incompleteness and fragmentary character of unofficial information relating to foreign crop prospects.

The report of the present year contains a review of the course of agricultural production during fifteen years, which shows an estimated increase in corn of 37,000,000 acres, or 80 per cent.; in wheat, of 20,000,000 acres, or 108 per cent.; in oats, of 13,000,000 acres, or 142 per cent.; in all cereals taken together, 67,000,000 acres, or 97 per cent. The enlargement of the wheat area was extraordinary during the period of partial failure of the crops of Western Europe; the extension of the breadth in maize was aided by the rise of the foreign trade in beeves and fresh meats, and by the sudden enlargement of exports of pork products, induced by the cheapness of corn; and the cultivation of oats has received especial impetus from the seeding of rust-proof varieties in the South, and from the necessity of less heating feed for horses than a too exclusive maize ration. The increase from 69,000,000 acres of cereals in 1870—a breadth nearly equal to the superficial area of Missouri and Ohio—to 136,000,000 acres, an increase of 67,000,000 acres since 1870, means the seeding and harvesting of additional area equal to the entire surface of Iowa and North Carolina.

The average estimated area and product of the principal food crops of the last five years is compared with the average of the ten years preceding, from 1870 to 1879, inclusive, as follows:

Crops.	1880–'84.		1870–'79.	
	Bushels.	Acres.	Bushels.	Acres.
Corn	1,575,194,194	66,045,016	1,184,486,954	43,741,331
Wheat	463,973,098	37,738,882	312,152,728	25,187,414
Oats	495,509,478	18,628,029	314,441,178	11,076,822
Rye	26,380,399	2,088,665	18,460,985	1,305,061
Barley	49,324,670	2,214,154	33,704,652	1,529,357
Buckwheat	10,781,793	847,096	9,747,272	551,104
Potatoes	169,241,133	2,112,378	132,837,175	1,514,045

The average yield of corn per acre has been 23.9 bushels per acre, against 27.1 for the preceding period; the average value has therefore been higher, 44.7 cents per bushel instead of 42.6, and the average value of an acre $10.67 instead of $11.54.

The average yields of wheat in the two periods are nearly identical, 12.3 and 12.4 bushels, respectively, but the price has averaged 90.1 cents, of 104.9, the demand not being equal to the supply.

of the present year are ample for all the demands of con-

sumption and exportation. The cereal supply promises to avera about 52 bushels to each unit of population. Winter wheat suffer greater injury during last winter than in any season since 1866. Se eral millions of acres were given up to spring crops, and the remaini breadth scarcely averages 10.5 bushels per acre. The spring and wi ter wheat together is approximately estimated at 350,000,000 bushe

The corn crop promises a volume 10 per cent. greater than that last year, or nearly two thousand million bushels, and that of oats w probably exceed six hundred million bushels. There has been a lar reduction of the expected yield of potatoes in consequence of the serio prevalence of rot in New York and various degrees of injury from t same cause in other States.

The increase in cotton area insures a crop of nearly 6,000,000 bales the rate of yield no greater than that of last year. The high promise the early season has not been maintained, though condition is not y as low as in 1884 at this date. It is safe to say that the crop will b between 6,000,000 and 7,000,000 bales, and, however short and unfavo able the picking season, only exceeded by the crop of 1882.

Included among the unfinished investigations of the year is the b ginning of an important statistical work, an agricultural survey of t resources, rural industries, and capabilities of the Rocky Mountai region. It is a work of great practical utility, tending to the industri development of that broad domain and the enlargement of the materi resources of the country.

In addition to statistical inquiry which relates directly to the cond tion of growing crops and the yield thereof, there have been institute inquiries, by specialists, into certain branches of agricultural and ho ticultural industry, and the reports, as soon as completed, will be la before the public.

DIVISION OF GARDENS AND GROUNDS, HORTICULTURE, ETC.

The duties of this division embrace all that relate to practical hor culture, floriculture, tree-culture, and landscape gardening.

Questions having for their solution the relative value of econom plants of new or untried kinds, and the probability of their successf commercial culture in climates and localities suitable for their comple growth, and the proper course to be pursued in their introductio propagation, and dissemination, are subject matters which pertain to t division.

There are many plants of great economic value which, so far as grow is concerned, can be placed in suitable climates in this country, b which, for various reasons, cannot at present be recommended or e couraged as offering a probability of profitable culture.

Others, again, such as are nearly of a tropical nature, can only be p duced in limited areas, with the prospect of an occasional failure duri seasons of more than usual severity.

The coffee plant may be mentioned as an example of plants of this description; cinnamon, gamboge, some of the rubber and other gum-yielding plants, chocolate, vanilla, and nutmeg may also be noted as coming under this class.

Some plants again, even where the thermometrical conditions are favorable, require special climatic conditions to secure their production in profitable quantities; the tea plant is a good example of a plant requiring special climatic peculiarities to enable its commercial products to be produced in sufficient abundance to be profitable as a mere money investment, while it can be cultivated and made available as a domestic article for family use over a large portion of the country.

There are many articles of importation which can be grown here, but can be purchased at so cheap a rate that our system of labor cannot compete t r production. Of these opium may be noted; the opium poppy may ltivated in every State of the Union, but the slow and tedious ipu ion required in collecting the juice prevents competition with ch labor of other countries. The same factor prevails in culti ion and preparation of perfumery oils and essences, but in , as in other industries, much can probably be accomplished by the inv on of new appliances of a labor-saving character.

e of the ramie plant, which yields a valuable fiber, and roduced many years ago, has hitherto been held in abeyance the want of machinery adapted to the profitable extraction of the fiber from the stalks. This is now so far accomplished that ete success of a machine for the purpose may be looked for in

ture has en in a similar provisional condition, and as soon u e nt is confirmed that suitable machinery has been l the r ion of these plants, and for the separation of their in m tisfactory to the cultivator and to the manufacturi w and profitable crops will be at once available.

introd ion of new industries is at all times a matter of spe- e , they promise a direct addition to the industrial weal d ing resources of the nation, and, what is further of im ce, y have an indirect value in so far as they increase y crops a widen systems of rotation on lands, which is a t f or in maintaining the fertility and in the economical man- of the soil.

ing promises to be more effective in this direction than the in- fruits into every section where they will thrive and do not e , the careful experimentation with new varieties of such as r o be tried. Our farmers are American in every sense, rul e an almost immediate return as a reward for their ; wn in the spring yields its product in the fall, and hence year after year, with little or no diversity, which

should they become the sites of orchards of the most common
of fruit would, in due time, amply repay the planter for both his
and his patience, and, what is of greater importance, would furn
that diversification which must ultimately become the necessity of ou
agriculture.

I would respectfully recommend, therefore, that this division of th
Department be sufficiently enlarged in scope and power to enable
to appoint a special superintendent or agent of pomology, who
give special attention to the pomological necessities of the country,
make suggestions relative to the industry as applicable to every se
tion for the guidance of the horticulturist.

Such an agent, if qualified for his duties, could, through his r rt
give to the country a mass of information which would be of
benefit to all concerned.

So far as regards experimental work in connection with objec
culture in gardens and orchards, the area of the Department gr
which can be devoted to this object is now so limited as to pr
practical tests of the merits of varieties of fruits, and its expos
tion subjects all operations to interference by depredators who are ma
liciously inclined. Even for purposes of propagating out-door plant
the grounds are but of little avail, because their situation in the cit
prevents a guarantee of accuracy of nomenclature.

The introduction and propagation of semi-tropical plants of eco mi
value are receiving considerable attention, but the facilities are
gether inadequate to the prosecution of this work on a scale suffi
extensive for the demands of the country. These demands can
fully met until the Department secures ample facilities for thor
testing and propagating such plants as oranges, lemons, figs,
cinchona, mangoes, &c., in the open fields in States where the climat
admits of such cultivation.

The distribution of economic and other plants during t
amounted to 74,000. These consisted of oranges, lemons, oli
goes, guavas, figs, tea, coffee, Japan persimmons, pine-app
grapes, native and foreign, strawberries, raspberries, also mul
plants for silk-worm encouragement, and a few ornamental ts
[illegible] kinds.

[illegible] METEOROLOGY.

[illegible] ge of temperature, t pr
[illegible] ation are among
[illegible] production. Our climate subjec
[illegible] which by turns stimulate power
[illegible] y of plants. The European vi
[illegible] anging conditions, except on the I fi
[illegible] ardy as they are, find an unre
[illegible] following excessive

causes many diseases of fruits and grains, cotton and other plants. The cotton crop of the present year has been reduced materially by unfavorable meteorological conditions, by a failure of the preservation of a due balance between the forces of heat and moisture.

There are investigations of a practical nature in agricultural meteorology which have not yet been made; there are problems which have not yet been solved. The practical application of this as yet undeveloped science is of very great importance and should receive the immediate attention of official and experimental organizations. To this end I would suggest, and venture to urge, the establishment of a signal-service station in connection with each college of agriculture and agricultural experiment station, for the routine work of the signal service and for special observation, under direction of the college or station, for investigation of meteorological conditions affecting the health and growth of plants.

MEDICINAL PLANTS.

For a number of years past the attention of medical men and pharmacists has been unusually attracted toward the subject of medicinal plants, both native and foreign, and the last annual meeting of the American Pharmaceutical Association by resolution requested the Commissioner of Agriculture to take measures for the introduction into cultivation in this country of such of the important foreign medicinal plants as may be adapted to our climate, in order that they may be readily obtainable in a fresh state, and that another industry may be added to our country's resources. It is represented that many hundred thousand dollars are annually sent abroad for drugs and medicinal substances that should be produced at home. There is no doubt that many of the most important medicinal plants, as the rhubarb plant, the licorice plant, arnica, belladonna, digitalis, opium poppy, and many others are perfectly adapted to our climate, and could be cultivated in perfection, as we know with respect to some of them, from experiments made many years ago. Some other semi-tropical products, as ginger, cinchona, vanilla, jalep, and sarsaparilla, may in all probability be successfully cultivated in the extreme southern portion of the country, and it would seem well that means should be taken to give such plants a proper trial.

A new a[illegible] powerful anæsthetic remedy prepared from the leaves of a[illegible]b[illegible]d coca, or botanically *Erythroxylon coca*, has been re[illegible]ed into medical and surgical practice.

[illegible]sh[illegible] is a native of Central and South America, and on account [illegible]dif[illegible]ulty of o[illegible]ning the leaves in a fresh and active state, it [illegible]y desirable that the growth and cultivation of [illegible]tempted, in some locality, within our own borders. [illegible] our native medicinal plants and drugs, their collec[illegible]e been very greatly extended during the past dec-

ade, so that thousands of people in different parts of the country, not ably in the mountainous regions of North Carolina, Tennessee, and i other Southern and Western States, are employed at certain seasons o the year in this enterprise.

Fears are expressed that some of these plants are becoming exterm nated in their native habitats, and in respect to some of them—as, fo instance, the ginseng plant—the time has come when they may proba bly be made the objects of profitable cultivation.

EXPERIMENTS IN ALASKA.

Something in the line of experimental work might also be undertake in Alaska, possibly with profit. It is well known that the Departmen if the Interior has established an agency for the promotion of educa tion in that Territory.

It has been suggested that a line of experiments, to be undertake by this Department, would easily prove whatever of agricultural an horticultural capability may exist in the Territory. No careful atten tion seems to have been given there, as yet, to this branch of industry and the resources of the country are quite unknown and undeveloped

The Industrial Training School at Sitka would furnish an admirabl basis for a station, where could be conducted careful experiments t ascertain the agricultural products best adapted to the climate and soi of the Territory, and what breeds of cattle and other domestic animal are most suited to its climate and soil.

Such an experiment ought to extend over a series of years, and th result would amply repay any expenditure that Congress may choos to make in this direction.

DIVISION OF BOTANY.

The work of this division during the past year has been prosecu with vigor, and may be classified under the following heads:

(1) Care and enlargement of the herbarium.

(2) Publication of botanical matter.

(3) Distribution of duplicates and foreign exchanges.

The herbarium contains botanical specimens of all the plants of th United States, so far as it has been able to secure them, and also a larg representation of foreign plants. These specimens are a necessity i order that the division may be able to distinguish and determine th names and properties of the plants sent in for investigation and identi fication from all parts of the United States. It is, in fact, a kind o reference library to be consulted whenever occasion requires, and l both scientific and practical importance. The development of t great country is constantly bringing to light new kinds of plants, som of which have uses, medicinal or economical, and information as to thei relationship and probable qualities has to be sought for largely throug

the medium of the herbarium and its library. The herbarium has also a high value for consultation by teachers and professors of botany, who frequently avail themselves of the opportunities here afforded of studying plants from every part of the Union.

This advantage is participated in also by educated foreigners, who in visiting the capital of the country expect to find centered here a full representation of its various productions. Such collections are a necessity of the education of the times, and every country of the world, which is advanced in intelligence and science, makes its capital the headquarters for information of all kinds relating to its resources and productions, thus fostering that spirit of scientific research to which the highest progress of the world is so much indebted.

The heretofore crowded quarters of the herbarium have been relieved by the addition of more room.

The appointment of an assistant has been made, whose special duties are to investigate the fungus diseases of plants, a line of botanical research which has been most urgently called for and which it is expected will soon show valuable results.

A "Descriptive Catalogue of the Grasses of the United States," intended, in part, to be explanatory of the display of grasses made at the New Orleans Exposition, was prepared by this division. It was published by the representative of the Department to the said exposition, and has been widely distributed to granges, agricultural colleges, and persons interested in a knowledge of our grasses, and has received much commendation from the press and from scientists.

The report of this division shows descriptions and figures of a number of species of native medicinal plants, a subject which is now receiving considerable attention, and of which it is desirable that information should be furnished to the people.

This division still continues the plan of distributing duplicate specimens of plants to such agricultural colleges as make requests for them.

Duplicates have also been used in making exchanges with societies and institutions of science in foreign countries. The division is greatly indebted to the Imperial Botanic Gardens of St. Petersburg, to the Museum of Natural Sciences at Paris, and to the Royal Botanic Gardens of Great Britain, for valuable contributions to its botanical collections, and responses have been made as far as possible, by contributing to their similar wants.

The work of this division has been yearly increasing, and it now stands in urgent need of an addition to its force, in order that proper researches may be made, and that useful information on botanical subjects may be diffused among the people.

DIVISION OF FORESTRY.

is, perhaps, no subject in which the Department can be used benefit than in its attention to forestry interests; and, con-

sidering the vast importance to the nation of a proper investiga
the subject, no branch has been more poorly endowed by Congre

An appropriation of $10,000 has been made annually for several
for an investigation of this character, and a reasonable amount o
has been yearly accomplished, as may be seen by the various r
already published. These reports have dealt with the condition
estry matters; statistics relative to the industry have been
set forth, and various suggestions have been made when thou
value. Much remains to be done in this direction; but the tim
come when more than this is necessary, if we would be awakened
dangers which threaten us through the destruction of our forest
more important problem confronts us as a people than that wh
lates to our forests. Efforts should be made at once to further
and enlighten the people. The establishment of arbor days, whi
been so successfully accomplished in a few States, should become ge
the importance of the introduction of forestry into our schools an
cational institutions should be set forth; the organization of lo
State societies in the interest of forestry should be strongly adv
and encouraged, and every other means should be devised to
into the minds of the people that restoration is an urgent necessit
must keep pace with destruction.

It is already apparent that efforts for promotion of forest-tree
ing, through liberal laws on the part of the United States, and th
various premiums and exemptions on the part of certain Stat
not to meet with abundant success. Inducement having failed,
tion should now be attempted. Such an effort, to be successful,
to be inaugurated by the General Government itself. Adequate
should be forthcoming to deal with this national necessity in a na
way. With a sufficient fund, agencies could be established to
information for compilation and diffusion; the laws of foreign cou
in this regard could be codified and studied; climatic and meteo
ical observations could be made in sections to show the influe
trees; a comprehensive study of the varieties of trees and their s
economic uses and values could be laid before the country, and in
ther ways the people could be made to realize the vital impor
his subject.

I have submitted an estimate for $10,000 to continue these inv
which they have been prosecuted in pr
ngress deem it wise to increase the scope
ions somewhat commensurate with its
line of work to which I have al
ental plots for forestry upon th
nprehensive discharge of the
appropriation.
ng o the division undertook, in conn
intend Buildings and Grounds, and under the

Congress providing for contributions from the various Departments of the Government to the Centennial and Cotton Exposition at New Orleans, to promote the interests of forestry by procuring and sending to that exposition, a collection of useful and ornamental articles manufactured from the woods of our forests. The great variety of articles thus brought together constituted one of the most interesting and attractive features of the exposition, and had the effect of giving to many, a new and deep impression of the great value of our forests and the importance of their proper protection.

As tending to show the practicability of tree-culture in the arid regions of the West, where such culture has been deemed by many to be impossible, the division transplanted several hundred trees of various kinds from the western portions of Kansas and Nebraska, and the regions farther west, and exhibited them in a growing condition on the exhibition grounds, thus giving ocular demonstration of the success attending tree-planting in a large section of the country hitherto treeless, but where, within a few years past and with advancing settlements, millions of trees have been planted and are now flourishing. The established fact that trees valuable for fruit, for shade, and for timber can be successfully cultivated on much of the dry plains of the West, is of the greatest importance in an agricultural point of view, and will be the means of attracting settlers to that region who would otherwise turn away from it.

Early in the year a new volume of the reports on forestry, in addition to the three previously issued, was published. Among the more important contents of this volume may be mentioned a full report from six of the prairie States, in regard to the kinds of trees that had been found to grow there successfully and to which preference is given; also as to what kinds of trees have not proved successful and the difficulties which have been met by tree-planters.

Another report, compiled from the returns made in response to a second circular, gave an exhibit of the extent to which the native forests of the country have been cleared off, and for what purposes, and the damage occasioned by forest fires, together with other facts relating to the subject.

By means of a graphic chart, the steady and rapid destruction of the forests in one of the States during a period of nearly thirty years was presented to view, and will serve as an illustration of what has been taking place in many of the other States.

A report was also made in regard to the consumption of the forests the purpose of furnishing ties for our 150,000 miles of railroads. ort shows the amount and kind of wood used by each railroad ch information could be obtained, amounting to about 63 per of whole. The sources from which the ties are procured are also the season of the year in which they are cut and their durability. From this report it appears that to furnish ties

for our present mileage of roads has taken the available timber from an area of land equal to that of the States of Rhode Island and Connecticut, and estimating that the ties will need to be renewed once in seven years, there will be required for this purpose, and to equip the new roads built from year to year, the timber growing on 565,714 acres. Allowing, again, that a growth of thirty years is necessary to produce trees of proper dimensions for ties, it will require 16,971,420 acres of woodland to be held as a kind of railroad reserve in order to supply the annual needs of the existing roads, to say nothing of the demands for new roads. This constitutes an area larger than the States of New Hampshire, Vermont, and Massachusetts combined. It is more than 4 per cent. of the woodland of the United States, exclusive of Alaska.

The volume contained, also, a report on the maple-sugar production in the United States and Canada. From this it appears that, reducing the maple sirup made to its equivalent of sugar, the total maple-sugar product of the country for the census year was 50,944,445 pounds, or a little more than one-twelfth of the whole sugar product of the country, including that from sorghum and the sugar cane. Of the granulated sugar made in the country that from the maple forms 17 per cent.

Since the publication of the volume referred to, two other circu have been distributed, and the division has been occupied in com r- ing and tabulating the information thus obtained. The inquiries m in these circulars were in general as to the methods adopted in tree planting and culture, the increase or diminution of the forest area, the observed influence of the presence or absence of forests upon streams, floods, and droughts, and also upon climate.

During the year about 3,000 packages of tree-seeds have been sent to persons who have applied for them, or to those who it was thought would subject them to various modes of culture and test their adaptation to various soils and climates.

Since the organization of the "American Forestry Congress" the Department of Agriculture has recognized it as doing a kindred work with that of its forestry division, and has given it whatever aid it could by the presence of its officers, and contributions of information in its possession.

In view of the great and constantly increasing demands made upon the forests for the supply of ties and other material for the use of rail- [illegible] has become a question whether the companies might [illegible] to be a feasible thing, and for their interest, to plant [illegible] roadways, or on tracts of their land adapted to the pur- [illegible] benefit themselves while at the same time relieving the [illegible] ident from an onerous demand which is [illegible] and-grant companies have an abundance [illegible] with trees or which might be planted, [illegible] perpetual supply of timber, and these and

other companies, by planting a belt of trees along their lines, could protect their roads from drifting snows and driving winds.

The review of the year is encouraging. The interest in the subject of forestry has increased throughout the country. The publications of the Department by themselves, and yet more as they have been republished in whole or in part by our numerous newspapers, and the discussions of the subject in agricultural and other conventions, have had the effect to extend greatly the knowledge of the subject.

The establishment of arbor or tree-planting day, already adopted in fifteen of our States and Territories, is one of the most encouraging signs for the advancement of forestry. Its extension throughout the country should be urged by every proper consideration. Its general establishment would be among the most effective means of creating throughout the community a proper sentiment in regard to trees, and lead to their adequate protection.

On the other hand, the waste of our forests goes on at an alarming rate. Little, if anything, has been done to check the annual destruction by fires, whether by willful violators of the law, or where occasioned by sparks from locomotives; the destruction caused by the ax of the lumberman, or the loss by depredations on the public lands. To stop these several losses, each lamentably great, the division has done what it could by making the facts known to the Commissioner of the Land Office, the only one who is authorized to prosecute such offenders.

In view of the continued destruction of the timber on the Government lands, and the importance of preserving for permanent cultivators, and use, such portions of forests as are adjacent to the head springs of rivers, or which may be needed for climatic or other reasons, it is respectfully urged that the further sale of timber lands belonging to the Government, ought to be suspended until such time as a careful survey shall ascertain what portion of them may be sold without involving injury to the country, and what ought to be permanently held in the forest condition.

SEED DIVISION.

R ive t r ituted, those in the seed division call
) tl noti It is a division whose annually ex-
o ion tl of any other in the Department, and
io to s uld care and wisdom in its management.
] ıtion l ther e been given to improved methods in
ril seeds. Ex nced executive officers have been ap-
event an indiscriminate and useless distribution of seeds
ils to which they are not adapted; to carefully study
ıd climatic condition of the several sections; to thor-
, fore distribution, a sample of every variety of seed pur-
ove its vegetative qualities, and to skillfully subject such
ı examination for the purpose of detecting the presence

of seeds of noxious weeds, injurious insects, or the germs of disease. Improved methods have also been applied to the handling of seed in its receipt, its preparation for distribution, and its final disposition; and it will be my endeavor to continue to inaugurate new and improved systems as rapidly as the service may require.

For a continuation of the distribution, as required by the present law, I have submitted the usual estimate. There is one phase of the law, however, to which I would respectfully call your attention. It requires that a report of experiments shall be made by those receiving the new and valuable seeds which the Department distributes, the evident intent being that the Department shall be kept informed of the success or non-success of experiments with seeds which it purchases, especially for experimental purposes. In a vast majority of cases this design of the law, unfortunately, is not complied with.

Two-thirds of all seeds, plants, and cuttings may be distributed by Senators, Representatives, and Delegates in Congress direct, and their constituents do not feel in duty bound to report results to the Department. It is obvious that these representatives of the people are better acquainted with the best intelligence and needs of their respective districts than the Department is; while, on the other hand, it must be admitted that the Department understands better than others, the nature and habits of the seeds and plants it distributes; and it is a matter for serious consideration on the part of Congress whether or not some systematic plan of co-operation may not be fixed upon between this Department and Members of Congress, by which the former can have a better control over the distribution than it now has, and make the distribution a condition precedent to a compliance with simple but important requirements, and thus reap the greatest benefit from the distribution; while the latter can continue to give the Department the benefit of advice and experience by furnishing lists of those who can best serve the interests of their several localities, by carrying on experiments to test the value of the seeds and plants distributed.

Another reason for a change of systems, in this respect, is that the quota of one-third of all the seeds, &c., purchased, at present allowed to the Department, is insufficient to enable it to meet its own legitimate debt of obligation to its thousands of correspondents, and others who can receive no other favor from the Department in consideration for important and valuable services rendered. The Department keenly feels [illegible] debt should first be met, and the remaining seeds are not sufficient [illegible] in a comprehensive manner. The intelligence of to-day, with whom the Department [illegible] give the requisite attention and time to [illegible] not be asked to do so, nor would such [illegible] any great benefit. No good can come from the [illegible] seed where a bushel is needed.

MICROSCOPICAL DIVISION.

The microscopist has been chiefly engaged during the past year with investigations relating to the general microscopic characteristics of pure dairy butter, oleomargarine, butterine, and other butter substitutes, with a view of discovering some well-defined mode by which pure butter and the various butter substitutes, offered for public sale, may be distinguished from each other, thus protecting the public against fraudulent compounds sold as pure butter.

These investigations have necessitated hundreds of experiments with the fats of various animals and of vegetables, as several of these fats are largely employed in the manufacture of all butter substitutes. The want of a ready and scientific means of determining whether a substance offered for sale is really butter, or butterine, has long been felt by chemists, butter inspectors, and the public generally.

Because of the question among chemists in Europe, and in America, as to the possibility of determining, by purely chemical means, butter from oleomargarine, the butter laws of the United States, as well as those of Great Britain, have been rendered inoperative, as regards the successful prosecution of violators of the law relating to butter imitations. Hence the great desirability of endeavoring, by the use of the microscope, or other untried means, to discover a method, or methods, by which the butter laws, generally considered, shall be rendered useful and operative to the dairy interests of the United States.

After many experiments in this direction, the microscopist claims to have discovered that lard made from swine's fat always exhibits crystals in stellar form, wholly composed of sharp, fatty, needle-shaped spines radiating from a common center, while the fat of beef yields foliated, serrated, and bi-serrated spines proceeding from a common center, but much smaller than those of lard, while pure normal dairy butter is wholly exempt from fatty crystals, and this distinction is constant. He also claims to have discovered that when pure butter is boiled in a test tube, without water, for a period of several seconds only, and allow to cool for a period of twenty-four hours, at a temperature of 60° Fah., s treated becomes crystallized in globose forms, generally pe ctly g bular, and of sufficient size to be detected by the naked eye. subjecting these crystals to polarized light, in connection with osc , the crystals exhibit on each globule of fat a well-defined c bling that known as the Cross of St. Andrew, thus distin- g ing at once the fatty crystals of the butter from those of lard or In no case has he found crystals in any of them resembling those d in pure dairy butter. In consequence of the novelty of this dis- and its value to the dairy interests of the country, if verified by he was directed by the Department to submit the result of his ion of fats to the members of the American Society of Micro- their annual meeting held in Cleveland, Ohio, in the month of

September last, at which meeting he gave a statement of all the facts in this case, illustrated by eighteen drawings, of the respective crystals of fats thus far found in them.

A committee of five experienced microscopists, appointed by the president of the society to examine the method as detailed by the microscopist of this Department, subsequently reported the practical verification of this discovery.

In consequence of the development of these new facts, two convictions have been made during the past month, by two distinct juries of the criminal court of the District of Columbia, for violation of the butter laws.

This division has also prepared a description of edible mushrooms common to the United States, with such information as will enable inexperienced persons to avoid injurious species.

Examinations of milk, cream, cheese, water, parasitic injuries of plants, &c., have also been made.

As much extra work is now being imposed on this division in furnishing testimony for the courts in butter prosecutions, extended facilities will be required to enable it to continue its work of furnishing new facts; better instruments are needed, more room required, the laboratory rendered more complete, and the division library of reference extended. To meet these wants an expenditure of $2,000 is recommended

COUNTERFEIT BUTTER.

I beg to call special attention to the unparalleled increase during the past few years, of the manufacture and sale of various compounds of animal fats, vegetable oils, and other substances which are fraudulently represented to the public as butter. The extent of this business threatens the destruction of the legitimate dairy business, the interests of which are of the largest magnitude, and affect all sections of the country. It is not competition with dairying that is deprecated, but the simulation of true dairy products, the deception of misleading names the use of impure substances, and the dishonest sale, at high rates, of products otherwise of little value—practices which demoralize trade, defraud honest industry, and endanger health.

To protect the public from these deceptive practices, I would earnestly recommend the prompt passage of a stringent law by Congress to prevent the continuance of this business, except under such regulations as the necessities of the case demand, the enforcement of this law to be under the control of the Internal Revenue Department.

INDUSTRY.

[illegible] 1, 1880, authorized the Commissioner of [illegible] the International Sheep and Wool Show to be held in Philadelphia in September of that year, and to make a report

thereon. At that exhibition there were collected samples of wool from the different breeds of sheep exhibited, and their examination undertaken with a view to their careful measurement for fineness of fiber, tensile strength, &c. As this examination progressed, it became apparent that most valuable information, both for the producer and consumer, would result. The samples were largely augmented by contributions from every wool-producing section, and a careful, patient, and elaborate system of tests, and examinations, was entered upon to show the varying tensile strength, ductility, and elasticity of wools from different breeds of sheep, and from the same breeds, under different conditions of feeding, climate, and management. The report upon this investigation has long since been ready for the printer, the illustrations to accompany it having been prepared and paid for. The work is a scientific indorsement of the value of American wool. It shows clearly that wool can be produced in the United States equal to that of any country in the world, and embraces information which has cost many thousands of dollars to procure and tabulate. The great wool industry is entitled to the information which it was the evident design of Congress it should have, and I would respectfully urge the importance of the immediate printing of the report for the benefit of all concerned.

DEPARTMENTAL REPORTS.

In addition to 400,000 copies of the Annual Report of the Department for the year 1884, and 50,000 copies of the First Annual Report of the Bureau of Animal Industry, both of which were ordered by special act of Congress, the following named special, and miscellaneous reports, have been published during the current year:

DIVISION OF STATISTICS—NEW SERIES.

	No. copies printed.
No. 14. Report of the crops of the year, and of freight rates of transportation. December, 1884, 60 pp., octavo	13,000
No. 15. Report upon the numbers and values of farm animals; on the cotton crop and its distribution, and on freight rates of transportation companies. January and February, 1885, 64 pp., octavo	15,000
No. 16. Report on the distribution and consumption of corn and wheat, on consumption of cereals in Europe, and on freight rates of transportation companies. March, 1885, 47 pp., octavo	15,000
No. 17. Report of the area of winter grain, the condition of farm animals, and on freight rates of transportation. April, 1885, 80 pp., octavo	15,000
No. 18. Report of the condition of winter grain, the progress of cotton planting, and wages of farm labor; also on the freight rates of transportation companies. May, 1885, 60 pp., octavo	15,000
No. 19. Report on acreage of spring grain and cotton, the condition of winter wheat, and European grain products, with freight rates of transportation companies. June, 1885, 56 pp., octavo	15,000
Report on the area of corn, potatoes, and tobacco, and condition of growing crops, and on rates of transportation. July, 1885, pp., 64, octavo	15,000

	No. copies printed.
No. 21. Report on the condition of growing crops, of international dairy statistics, and on rates of transportation. August, 1885, 70 pp., octavo	15,000
No. 22. Report on condition of crops in America and Europe, and on freight rates of transportation companies. October, 1885, 55 pp., octavo.	15,000
No. 24. Report on the yield of crops per acre, and on freight rates of transportation companies. November, 1885, 54 pp., octavo	15,000
Agricultural Graphics. A report of exhibits illustrating agricultural statistics at the World's Industrial and Cotton Exposition at New Orleans, La., by J. R. Dodge, Statistician of the Department. Illustrated by twenty-seven diagrams. 42 pp., octavo	3,000

ENTOMOLOGICAL DIVISION.

Bulletin No. 1. Third edition. Reports of experiments, chiefly with kerosene, upon the insects injuriously affecting the orange tree and the cotton plant, made under direction of the Entomologist. 62 pp., octavo	500
Bulletin No. 5. Description of North American Chalcididæ from the collections of the United States Department of Agriculture and of Dr. C. V. Riley, with biological notes. Together with a list of the described North American species of the family. By L. O. Howard, M. Sc., assistant, Division of Entomology. 47 pp., octavo	1,000
Bulletin No. 6. The imported elm leaf-beetle. Its habits and natural history, and means of counteracting its injuries. 18 pp., octavo	1,000
Special Miscellaneous Report No. 8. Cotton in the Empire of Brazil; the antiquity, methods, and extent of its cultivation, together with statistics of exportation and home consumption. By John C. Branner, Ph. D. 79 pp., octavo	2,000
Bulletin No. 8. The Periodical Cicada. An account of Cicada Septendecim and its Tredecim race, with a chronology of all broods known. By Charles V. Riley, Ph. D. 46 pp., octavo	2,000
Special Report No. 11. Fifth edition. The Silk Worm; being a brief manual of instructions for the production of silk. By C. V. Riley, M. A., Ph. D., Entomologist. 37 pp., octavo	2,000

CHEMICAL DIVISION.

Bulletin No. 5. The sugar industry of the United States.—Cane, beet, sorghum, and maple sugar. By Harvey W. Wiley, Chemist, Department of Agriculture. Illustrated. 224 pp., octavo	10,000
Bulletin No. 6. Experiments with diffusion and carbonatation at Ottawa, Kansas, campaign of 1885 By Harvey W. Wiley, Chemist. 20 pp.,	2,000

FORESTRY DIVISION.

[illegible] the year 1884 By N. H. Egleston, chief of	5,000

[illegible] REPORTS.

[illegible] of the United States. By D. M. Nesbit, [illegible] United States Coast Survey, S. L. Boardman, [illegible] other[illegible] 59 pp., octavo	3,000

	No. copies printed.
Special Report No. 9. Proceedings of a convention of delegates from agricultural colleges and experimental stations held at the Department of Agriculture, July 8 and 9, 1885. 196 pp., octavo.....	3,000
The soils and products of Southwestern Louisiana, including the parishes of Saint Landry, La Fayette, Vermillion, Saint Martin's, Iberia, and Saint Mary's. 40 pp., octavo	3,000
Report on the organization and management of seven agricultural schools in Germany, Belgium, and England. By A. S. Welch, LL. D. 107 pp., octavo.....	3,000
A directory of departments, boards, societies, colleges, and other organizations in the interest of agriculture, horticulture, stock-raising, dairying, bee-keeping, fish-culture, and kindred industries. 88 pp., octavo.....	3,000
Addresses of Norman J. Colman, United States Commissioner of Agriculture, and Dr. D. E. Salmon, chief of the Bureau of Animal Industry, before the third national convention of stockmen, held at Chicago, Ill., November 17 and 18, 1885. 29 pp., octavo.....	5,000

In conclusion, I beg to represent that the Department of Agriculture, growing in importance and usefulness as our agricultural population increases, and its wants and necessities multiply, should obviously be a progressive institution, in order to keep pace with the increasing demands made upon it. It is for the legislative branch to determine how far its importance shall be recognized, and with what powers it shall be clothed to enable it to partially meet the obligation which a country always owes to its agriculture.

Very respectfully, your obedient servant,

NORMAN J. COLMAN,

Commissioner of Agriculture.

REPORT OF SUPERINTENDENT OF GARDENS AND GROUNDS.

SIR: I beg to submit the following report on matters pertaining to this division. Although alluded to in former reports, I may again repeat that the very limited area of ground available for field work prevents operations in that line except upon a very small scale. Even the testing of the merits of the various new kinds of fruits, such as strawberries, grapes, figs, &c., has become very unsatisfactory in consequence of the unprotected condition of the grounds, owing to the absence of suitable fencing to prevent intruders who disarrange labels, extract fruits from plants under test, and otherwise interfere with the work on the grounds.

With plants under glass the conditions are more favorable, and with such plants as oranges, lemons, &c., the work of testing new or rare kinds, and propagating them, is prosecuted to the extent of the facilities at command. The work of the Department in this line is highly appreciated by those whom it serves.

My time has been much occupied during the present year and during the latter portion of 1884 in preparing exhibits for the Cincinnati, Louisville, and New Orleans expositions. The exhibit at New Orleans was the most important, and proved to be satisfactory and interesting. The leading principle I kept in view in the preparation of material for these expositions was that of presenting, as far as practicable, the operations of the various divisions of the Department and their relations to the industries represented.

In the performance of this duty I was ably assisted by the heads of the different divisions; notably by the entomologist, statistician, botanist, microscopist, and the chemist. By consulting with these gentlemen I was enabled to mature plans, and by their earnest co-operation these plans were executed, so far as time and means would permit. The time was exceedingly limited, and the amount of money appropriated for the work had to be considered at every step.

The reports, when completed, will present details of the exhibits representing the divisions; briefly, they were as follows:

The entomological division was represented by a collection made up of various sections, such as:

(1) *Insects injurious to agriculture*, arranged according to the particular plant and the particular part of the plant affected, and containing, as far as possible, the different stages of growth of the insect, its enemies and parasites, a statement of the remedies or preventives available, and a reference to the chief articles where full information can be found upon it.

(2) *Insecticide substances*, with a statement of the methods of using them, and the particular substance recommended for particular insects.

(3) *Insecticide machinery and contrivances for destroying insects.*—This
principally of the many useful contrivances which have been
and perfected by the entomologist.

(4) *Bee culture.*—An exhibit to show all the more valuable methods and contrivances now in use among advanced apiarians.

(5) *Silk culture.*—This exhibit was rendered the more instructive by having a structure where the worms were hatched and raised during the period of the exposition.

The statistical division was represented by a series of graphic charts. This method of illustration is the best interpreter of statistics to the popular mind. The object kept prominently in view in the preparation of these diagrams was to make the meaning of important facts in American agriculture so plain that they could be intelligently understood by those not accustomed to analyze the purport of figures. Among the more prominent of these diagrams were those (1) showing the proportion of land in farms; (2) increase of farm acreage in thirty years; (3) farm values of agricultural products; (4) values of farm animals; (5) increase of farm animals in thirty years; (6) progress of wheat production in thirty years; (7) exportation of wheat in fifty-eight years; (8) progress of corn production; (9) exportation of corn in fifty-eight years; (10) production of cereals in thirty years; (11) progress of cotton production; (12) area of cotton; (13) sugar production and consumption; (14) farm and forest areas, and many others of similar value.

The botanical division was represented by a very large collection of grasses, collected from all parts of the country. Among these a collection from the Western plains was notably interesting. These were arranged and displayed so as to represent their respective values, whether for hay or pasturage, and their ability to withstand dry summers or to be useful in dry sections and localities. The report of this exhibit is intended to illustrate these and other values of the grasses forming the collection.

The microscopical division was represented by a collection of water-color drawings, numbering about eight hundred plates, representing the leading types of the genera and species of fungi, embracing many of the edible and poisonous species found in this country; also types of the genera and species of the principal microscopic fungi which prey on living plants or are otherwise prejudicial to their healthy growth. This extensive collection was interesting and valuable.

The chemical division was represented by a well fitted and furnished sugar laboratory, with all appliances and apparatus required in the analysis of sugar-cane and its products. This was maintained in working condition, under the superintendence of a competent chemist, during the entire period of the exposition, who was constantly employed in making analyses of the products of sugar plantations. Another representation, which proved to be of much interest, was a working apparatus for the extraction of sugar by diffusion, as an economic substitute for the usual method of extracting the juice from the cane by mechanical pressure.

In addition to the above an elaborate display was made of sorghum sugar and the manufactures of which it is susceptible.

At the Centennial Exhibition, held at Philadelphia in 1876, where I had the honor of representing the Department in a similar capacity as at the late exposition at New Orleans, I prepared, as a part of the exhibit of the Department, a collection of American woods, which was acknowledged to be the best display of the kind made up to that time. Not considering it necessary to repeat that exhibit, I resolved to make an effort to form a showing of the *uses of American woods.* Although time was not allowed for its full completion as I had designed, yet among the selected specimens shown its value in relation to forestry and the

planting of useful timber trees in parts of the United States where tree-planting is recommended.

The manifold uses of certain kinds of timber are popularly well known, but there are many of what may be termed minor manufactures, for which various trees are employed, not usually considered as worthy of special notice, but which, in the aggregate, reach to surprising quantities, using largely of certain trees which may be expected in the near future to become scarce, unless the natural supply is supplemented by artificial plantings or stringent measures adopted for the preservation of young forest growths. In connection with this portion of the general exhibit, I have made an effort, through special circulars sent to wood-working establishments, to collect statistics regarding the amounts of woods used, the various species employed, the prices given for each kind, and whether the supply is diminishing and cost increasing, the best age of wood for particular purposes, and much other information not usually published, but which will be found to possess considerable value.

In the line of pomology I secured a series of plates of fruits, colored from specimens taken from the trees and accurately portrayed. Altogether something over 800 plates were prepared, comprising grapes, strawberries, raspberries, gooseberries, currants, apples, pears, plums, and peaches. These, supplemented by several cases of models of fruits furnished by the museum of the Department, formed an instructive display to all interested in pomology.

These pomological specimens, together with such exhibits of cotton and fibers of various kinds as were procured from the Department, have been returned. The exhibits of wood industries, entomological exhibits, and the microscopical representation have been turned over to the National Museum in this city. The statistical exhibit was donated to the Missouri University.

MILDEWS AND BLIGHTS.

Every person who has had any lengthened experience in fruit culture must be strongly convinced that the greatest drawbacks to success are those diseases designated as mildews and blights.

While this is now freely conceded, it is somewhat singular that the true cause of repeated failures in almost every fruit-growing section of this country has been so long and persistently ignored, seemingly on the ground that such apparently insignificant causes were altogether inadequate to account for the disastrous consequences that occasionally befell the fruit crops.

In no instance has this been so marked as in the case of the grape-
vi . The injury, and sometimes the destruction, of the entire amount
age on many of the best-flavored varieties, due to mildew, was,
a few years ago, generally stated to proceed from some cause then
nown.

s it would be explained by giving it the name of sunscald,
supposition that, in some way not clearly understood, it was
uuceu by the action of the sun on the foliage. The peculiar appear-
of d sed leaves gave strength to this opinion, and it was ulti-
ex ained that the injury proceeded from the lenses formed by
uro , or rain-drops, which burned holes in the leaves, and thus
the fruit crop.
the es not seem to be the slightest evidence that the
injured in the manner suggested, yet it is not
warnings in regard to wetting or watering plants

during sunshine, under the supposition that it will scald the foliage and destroy the plants.

It is true that the sun is a factor in causing the scalded and scorched appearance of the leaves of the grape, but it is only where the tissue has been destroyed by mildew that the action of the sun dries up the diseased portion, and where mildew is not present, the action of sunshine shows no injury whatever, even upon the healthy part of an injured leaf.

The delay to recognize the true cause of failure with many varieties of grapes in different sections of the country has had a disastrous effect upon the general introduction and extension of their culture. It has also led to heavy losses by individuals who have been induced to purchase costly varieties which they could not succeed in growing, on account of climatic conditions which they could not control. It well known that all varieties of grapes which are particularly sensitive to the climatic influences which promote the growth of mildew have little or no value for general cultivation, no matter how high the quality of their fruit may rank; but by far too little notice is taken of this particular by those who are introducing new varieties. If a variety is found to be of superior quality in one locality, it is extended under the supposition that it will prove equally valuable in all other localities; and if failures occur, as they so often do, they are freely attributed to bad or improper treatment on the part of the grower, and he will be blamed for neglect of some non-essential, which in future he secures, with no better result, and the industry is abandoned. The fact is strangely overlooked that, in special favorable grape-growing localities, an abundance of fruit is annually produced, even when all pronounced essentials to success are mostly wholly ignored.

When it was ascertained that the mildew of most frequent occurrence and of the most malignant character on native grapes was caused by an excess of moisture on the foliage, chiefly because of its subjection to continued heavy dews, it soon became evident that such locali had become renowned for continued successful grape culture, and where all varieties did equally well, were those where heavy dews were of the least frequent occurrence.

Microscopical investigations in regard to the diseases of plants are of comparatively recent date, and the deductions which have been made from them by microscopists are, to a certain extent, crude, owing to their want of practical knowledge in regard to vegetable physiology and the varied phenomena relating to cause and effect which are known to the experienced and observant cultivator.

Several years ago a microscopist assured grape-growers that the destruction of foliage caused by mildew was harmless, if not, indeed, beneficial, inasmuch as it permitted the sunlight more readily to act upon the fruit, and thereby assisted and hastened the ripening process. Such a suggestion displayed ignorance of the value of leaves to plants. Slight reflection would have shown that if such results followed mildewed grape-vines, complaints from growers would not exist. More recently it has been advised to remove and destroy by burning all the foliage which falls from vines injured by mildew, in order to prevent the resting spores of the fungus from attacking future growths, and thus stamp out the disease. As a matter of fact, the burning of the leaves would certainly destroy any resting spores attached to them but this would not therefore prevent similar attacks in the future whenever the climatic conditions proved conducive to the introduction and growth of the fungus

In newly-planted vineyards, even if they are on soil where grapes had never before grown, and although the locality may be a long distance from other vineyards, such plants will suffer equally with those in older plantations if the weather proves favorable to mildew. A vineyard may suffer severely from mildew one summer and be almost, if not wholly, exempt from it the following season, depending entirely on the weather. A young vine raised from seed in spring, on land where grapes were never grown before, is just as liable to be attacked by mildew on the leaves during its growth the first year, as if it was growing on soil where grapes had been growing for half a century.

It has been repeatedly proved by direct experiment that plants protected by a suitable covering which will arrest the upward radiation of heat and prevent dew on their foliage, will be exempt from mildew, although surrounded on all sides by mildewed plants.

This clearly proves that, in planting vineyards, a location should be selected where dews rarely occur, and investigations will demonstrate that the most popular localities for the profitable culture of the greatest number of varieties of native grapes at the present time are those regions where dews are seldom seen.

The rot in grapes has caused immense losses in the aggregate for a quarter of a century; for although it existed previous to that time, its effects increase as grape culture extends, until it threatens to cause the abandonment of grape culture in many parts of the United States.

This malady has baffled fruit-growers, and its cause is yet in doubt. Soils seem to have no perceptible influence, as it is found, some time or other, on all grades of soil from tenacious clays to pure sands, and in all locations high and low.

Some years ago it was found that bunches of grapes inclosed in paper bags soon after the berries had been fairly formed, would be exempt from rot, when bunches on the same plant, unprotected, would be attacked. Repeated experiments proved that covering the bunches was measurably a preventive of rot in the berry, and led to the conclusion that rot was produced by climatic causes, but the peculiar atmospheric conditions which favor its appearance have not been determined.

Since attention has been directed to the good effects of protecting the grape bunches from direct contact with the atmosphere, observation has been directed to the effect of allowing the bunches to be protected by dense foliage hanging in masses from the tops of the trellises upon which the vines are supported, and it is found to be of palpable value in the prevention of rot. Its value, however, if at all worthy of notice, can only be substantiated by repeated trials in various sections of the country.

It has been stated that recent observations tend to the impression that covered trellises, such as have been more or less in use for the last twenty-five years as a protection from the mildew (*Peronospora*), are also a protection from rot, a circumstance which might, in some degree, be expected. Although a close connection between mildew on the leaf and rot in the berry has not yet been demonstrated, it is not improbable that further investigations may prove such a connection to exist.

THE PEACH-LEAF BLISTER.

· and curl of the leaves of peach trees are not fatal in their
out either sometimes becomes severe enough to check the young
d dimin the value of the crop. *Curl* and *blister* are two
fr wo lly distinct causes. Leaf curl is caused
t s ant-louse. When these pests are nu-

merous on plants of any kind, their presence is indicated by the curlin and shrinking of the leaf. Leaf blister is produced by fungi, and is dis tinguished by the leaves becoming thickened and swollen into blisters which are whitish or faintly reddish on the upper and hollow on th under surface. The leaves thus attacked fall off in a few weeks and nev and healthy leaves are at once produced, and usually with but littl effect upon the quality or quantity of the crop. From the circumstanc that these diseased leaves are sometimes attacked by aphides, the blis ters forming an agreeable asylum for these lice, it is frequntly stat that the blister is caused by insects, and the terms *curl* and *blister* hav therefore come to be considered as synonymous by those who are no observant enough to perceive the difference between cause and effect i this case. Close observation would show that the blistered leav ar most frequently found to be entirely free from any of the aphis f ily.

The predisposing cause to leaf blister has long been recognized, d unlike some other diseases of the peach—the yellows, for instance—i perhaps universal wherever climatic conditions may prove favorable u its existence.

Its cause is entirely atmospheric, and it may be looked for, wi certainty of finding it, wherever sudden extreme changes of tem ture occur when the leaves of the tree are in a young state, or, in varieties, about the time of flowering.

In Britain, where the peach trees are generally trained on walls, an where mild winters are oftentimes followed by frosty spring weather the tendency to leaf blister is so common that measures are usuall taken to prevent it. Fifty years ago it was a common practice to cove the face of the wall upon which the trees were trained with evergree boughs early in spring in order to guard the young leaves against injur from cold. Trees which were not protected in this manner would b often severely injured from blister on the foliage, and even one-half of tree not protected would be attacked while the protected half would b perfectly clean and healthy. Portable glass coverings are now largel employed for this purpose.

A change of 30° in forty-eight hours in the early stages of growth wil produce peach-leaf blister. The most notable and most severe cas which we have met was a fall of 40° in twenty-four hours, with a col northeast breeze; its effects upon a row of peach trees planted about feet from, and on the west side of, a board fence, were, that in a few day the exposed tops were severely attacked by blister, while the lower por tions, protected in some measure by the fence, were all but uninjured.

It has been stated that this disease is contagious, and the advice ha been given to cut down and burn every tree thus attacked to prevent its spread and the total destruction of peach trees. This disease, how ever, is not contagious, and it is probable that none of these leaf disease are so; at least we have not had reason to consider them so from a lon observance of fungoid growth on plants.

Many years ago an experiment was made here with peach trees in pot and tubs which were grown in the orchard house. For the purpose o amplifying the origin of leaf blister several trees were removed to th outer air from an average temperature of 60° to 65°, varying from 75 o 80° during the day, to 50° or 55° during the night, and exposed unti he temperature fell to 38°. They were then again placed in the house n the course of a few days the leaves showed the effect of the cold an became badly blistered, but no blister appeared on other trees in th ouse, although the branches having blistered leaves were purposel ..termingled with those which had not been exposed to cold.

It has been recorded that in some seasons only certain varieties of peaches in an orchard will be affected with leaf blister, while other varieties are unharmed. Then, again, during a subsequent season, the varieties previously attacked will be unharmed, while those formerly exempt from the disease will be affected. This is accounted for by the condition of the growth at the time of a sudden injurious change of temperature. There is a certain period when the young leaves are most susceptible to such changes, and as this period is not reached at the same time by all varieties, some being earlier than others, it follows that some are injured while others escape.

It is also well known that in some seasons there are no blistered leaves to be found on any variety, the climatic conditions not being favorable to the development of the fungus.

There is much in connection with the appearance of mildew on the foliage of plants which would indicate that it is in most cases the result of cold or aridity in the atmosphere, or, perhaps, rather in their combined action. This seems to be more particularly observable in fungi of the *Erysiphe* class. The foreign grape-vine, as well as many other European plants, such as the hawthorn, lilac, &c., when subjected to our dry, hot atmosphere, suffer much from mildew. Even when the foreign grape is grown in glass structures, the utmost care must be taken in regard to ventilation during summer in order to avoid *Erysiphe* on the foliage; the admission of the outer air when it is 20° to 30° below that of the house will certainly affect the young leaves, at least those nearest the ventilator. It is a common observation that young roses may be kept during the winter in a pit or frame, where for weeks or months they receive no ventilation whatever, but as spring advances and the increase of temperature necessitates ventilation, then mildew makes its appearance on the leaves. It may be said that this is the result of careless management in the method of admitting the outer air to the plants, but, nevertheless, the best of management will not always prevent it.

A very dry air acting on tender leaves will cause an excess of evaporation which will produce cold on their surfaces; it is, therefore, perhaps more than a mere figure of speech to say that the appearance of Erysiphe on the leaves of plants is an evidence that, by some means or other, the plant is suffering from the effects of cold.

The disease called yellows has long been known; indeed, it is more than probable that the disease manifested itself upon the first attempts at the culture of the peach in this country. Amherst College authorities state that it was destructive in Massachusetts one hundred and twenty years ago. The cause of the disease has been a matter of uncertainty since its first discovery, and the various opinions which have been expressed regarding it can hardly be enumerated. The exhaustion or original deficiency of certain elements in the soil has been, and still is, a popular explanation as to the cause of yellows, but what particular ingredient or ingredients are lacking, provided that this is the cause, may be a matter of opinion. Dr. Goessmann, of Massachusetts Agricultural College, gives the following formula as a preventive, viz: 400 pounds of acid bone phosphate, containing 50 pounds phosphoric acid; 150 to 200 pounds muriate of potash, containing 100 pounds pot-
1 p nds crude sulphate magnesia. This is worked in the soil
ce of 10 feet about each tree. From experiments made at
the following mixture of commercial fertilizers is rec-
not only preventing but curing the disease, viz: 25 pounds
to 150 pounds muriate of potash, and 450 pounds dissolved

bone black, this being the proper quantity for an acre. If the trees ar in an advanced stage of the disease, more muriate of potash is to b added, giving about 4 pounds of this salt to an average-sized tree. I is very safe to remark, however, that no person ever succeeded in re storing a tree in an advanced stage of the disease of yellows, and n one who has had any experience with it will ever make the attempt The assumption that this disease is caused by a deficiency of particula elements in the soil cannot be sustained.

It is a common observation that, when trees become weakened fron impoverished soil, their foliage assumes a yellowish color. This is ob served not only in the peach, but also in the pear, cherry, orange, &c In fact, a yellow coloring of the leaves is a common index of a weak ened condition of a plant. On grape-vines seriously affected by phyl loxera at the roots, the young growths will assume a stunted, yellowisl appearance, which is perceptible from a considerable distance. Peac trees on poor soil have been seen to make yearly stunted growth with yellowish foliage, while yielding small, prematurely-ripening fruit and in fact, looking very similar to a tree having the yellows; but su trees are probably as far as possible removed from any likelihood o contracting that disease. It is quite in accordance with the every-da experience of those engaged in the cultivation of plants, that the bes method of restoring weakly trees, such as those just alluded to, is t enrich the soil, and it is also good practice to allow those that are i an advanced stage of poverty a more generous allowance than that give to those not so much in need; hence the benefit which has seemed t result from the application of potash, &c., to the roots of peach tree having yellow leaves may lead to doubt whether the color indicated result of impoverished soil only, or arose from the disease known amon peach-growers as the *yellows*. The latter is understood to be contagio and can be communicated to a healthy tree by pruning it with a knif previously used in cutting a diseased one.

One writer observes that when the "symptoms of yellows are mild i character and limited in extent," the trees should be limed and manured vigorously. He adds: "Follow this up with a little judicious pruning, and you have done all that seems practicable towards preserving, if no curing, your affected trees."

There is a difference of opinion regarding this contagious feature some holding to the opinion that the disease is transmitted by contact, while others are equally convinced that it is not so transmitted.

These seemingly conflicting opinions may arise from the supposition that all yellow indications of foliage result from one cause, which is not, we take it, the case; for all agree that when yellows is accompanied by a multitudinous growth of wiry, yellowish shoots on the older branches and stems, it is incurable. It may, therefore, be strongly suspected that in cases where an enrichment of the soil has cured trees of a disease supposed to be the yellows, the yellow appearance of the leaves has been due to impoverished soil alone.

Another cause of yellowness in peach leaves is that of the borer, which sometimes does great injury by destroying and girdling the bark just at or below the surface of the ground. The result of this insect depredation is often mistaken for yellows.

T. Fitz, in his work on peach culture, says: "The ravages of the yellows, as far as I know, seem to be confined to the Northern and Eastern States and some portions of the West."

Fulton in his work on the peach remarks that "the yellows is very

little known on the Delaware peninsula; what little we have seen of it," he says, "is supposed to have been introduced from New Jersey."

Rutter, in his book on peach culture, remarks that "the yellows appear more particularly after unusually wet seasons."

In the earliest writings on this subject the disease is referred to soil exhaustion, and the remedy suggested is to apply fertilizers, but we have ample proof that it is found on rich soils as well as on poor soils; neither is it found on all poor soils, because it can be shown that, in many localities where it is seldom if ever found, such as on the Delaware and Virginia peninsulas, the soil is quite as poor and impoverished as it is in any part of New Jersey where the disease is common. We are not prepared to admit that impoverished soil and neglected culture is the cause of the yellows in New Jersey and Michigan, and the converse of these factors, the reason why it is seldom found in the States of Virginia and North Carolina.

We have for more than a quarter of a century been strongly impressed with the opinion that the virulent disease known as yellows has for its origin the injury which follows the action of frost upon unripened shoots in the fall.

Our attention was first directed to this as a cause from the following circumstances: In the fall of 1851 we had several plants of the evergreen or Japan euonymus growing in a rich border, in a somewhat sheltered position. The weather, during August in particular, had been dry and warm. This condition of weather was followed by an abundance of rain and a mild temperature, which continued late and until vegetation was suddenly checked by a severe frost. The euonymus plants started to grow luxuriously after the September rains, making strong succulent shoots, the points of which were shriveled and blackened by the first frosty night, and most of the leaves below the blackened parts dropped from the stems. It was observed that these injured plants were tardy in commencing growth in spring, and the only buds that started were those at least one foot below the extreme points which still remained black and shriveled. This blackened portion was removed and no further special notice was given the plants that season. But after growing weather commenced in the following spring my attention was attracted to the quantity of young slender sprays which were growing from the stems to within 10 to 12 inches from the surface of the ground. These stems were clothed with small yellow leaves, remarkably similar to those which indicate yellows on the peach.

When cutting down below these yellow shoots in the fall it was observed that the interior of the branches was discolored, and had an appearance similar to what may be seen in a blighted pear branch; by pruning still closer this discolored wood disappeared, and afterwards strong healthy shoots were produced showing no signs whatever of disease.

This phenomenon appeared to be so similar to the external evidence of yellows in peach trees that it led to further observations in that direction, all which have helped to confirm the opinion that peach trees which make late soft growths and are caught by severe frosts while in this condition are those in which the yellows will speedily develop.

So far as known no person has ever met with a case of yellows in
h trees cultivated in glass structures. Of course the number of
trees cultivated in this way is very small when compared with
ch orchards of this country, but there have been many thou
trees grown in this manner, and the trees have been procured

from the same sources as other trees which have been destroyed by the disease.

Trees grown under a glass roof have every opportunity to finish and perfect their growth; the leaves assume the various tints of autumn coloring and drop in a natural manner as their duties are brought to a close, and wherever peach trees, when in a normal condition, whether North or South, evidence a completion and maturation of growth by a gradual change of their foliage from green to other colors, varying in different varieties, there the peach tree will remain healthy and no danger need be apprehended of yellows.

During the summer and fall of 1858 I had occasion to pass, several times each month, through a part of the county of Middlesex, New Jersey, and the course of my journey led me past a very beautiful peach orchard of some 20 acres or more in extent and apparently about three years planted. The soil was good and the culture seemed perfect; the surface was clean and no weeds to be seen. The deep green color of the foliage over the whole orchard, so far as could be seen, was well calculated to arrest attention, and this lively color was retained until it was suddenly struck with frost. I had passed it the evening before the frost occurred; next morning, at a place some 12 or 15 miles further north, I observed that the themometer indicated 11 degrees of frost. Three days afterwards I again passed this orchard; some few of the leaves had dropped but they mostly remained on the trees somewhat blackened in color, though all hanging down in a wilted condition and showing unmistakably that their functions had been suddenly arrested.

I observed that orchard for some years afterwards. The second summer after this freezing the trees were badly affected with the yellows; the branches were covered with the small wiry shoots so characteristic of this disease, which gradually extended, and, five years from the time that the trees were so promising, the entire orchard had been rooted out and the field set to another crop.

It has always seemed to me that, if this orchard had been properly pruned immediately after the freezing, it would have passed through uninjured. If all the young shoots had been pruned back to hard and solid wood, all probabilities of contamination from the diseased portions of the shoots would have been prevented—and it is a commendable practice, for other reasons besides the above, to shorten in the points of the strongest young growths of peach trees, this being one method of thinning the crop of fruit. A heavy peach crop usually means much poor fruit, for which there is no demand. There seems reason for the assertion that, if the rule were strictly observed to promptly shorten back the shoots of all peach trees which have been overtaken by a cutting frost while such shoots are still in a growing condition and while the leaves are unchanged from their green color, we should probably hear less of the destruction of peach orchards by *yellows*.

PEAR-TREE BLIGHT AND CRACKING OF PEARS.

[illegible] customary to ascribe all pear-tree blights and cracking of the fruits, as well as most fruit diseases, to the absence of certain mineral matters in the soil. Wood ashes was a popular prescription; a good dressing was considered a remedy; and where this application failed to prove effective, it was then claimed that there was deficiency of iron in the soil, and a dressing of iron filings was prescribed; even hanging up among the branches of trees such articles [illegible] scraps of iron was seriously recom

mended. After experiments had shown that these prescriptions were of no value, then electricity was assumed as the cause of blights and rots, which was equivalent to an admission that both the cause and remedy were alike unknown. About twenty years ago it was suggested that the active cause of decomposition in the case of pear and apple tree blight was of a fungoid character, and applications known to be fatal to fungi were then recommended and used with apparently good effects.

The opinion has been advanced, and in some instances the advice has unfortunately been followed, that when a tree first shows evidence of having a blighted branch, it should be rooted out as being beyond recovery. This is not good advice, for it is well known that trees, which have been so badly affected as to necessitate the cutting back of every branch close to the body of the trees, have again branched out and in time have borne good crops of fruit, and are no more liable to blight afterwards than any other tree which has never been attacked. Even where trees have been so badly affected that the entire stem had to be cut over close to the surface of the ground, young shoots have come up and have speedily grown into sound, healthy fruit-bearing trees.

The latest discovery regarding pear and apple tree blight indicates that it is caused by bacteria, a very low form of vegetable growth, classified much lower in the scale than fungi. Bacteria, it is stated, locate themselves on tender portions of the twigs, such as the extreme points of growing shoots, or in the opening flowers, or, it may be, in very soft and moist portions of the bark, and, from these spots favorable to their attachment, they enter into the shoots, and from them to the larger branches and follow on under the bark.

The experiments upon which the theory of bacteria, as the cause of blight, is based, are of much interest, and seemingly leave but little room to doubt its accuracy.

The deductions which micrologists form from the observations made on bacteria, lead them to the conclusion that external applications can be of no value by way of prevention from blight, and that it is futile to endeavor to cure a blighted shoot, and that the only resource is to cut out a dead or diseased branch and remove it from the orchard.

Practical orchardists will possibly have some opinions upon this point which may differ somewhat from the above conclusions. They will indorse the advice that it is useless to try to resuscitate a dead limb of a tree, and that the further advice to prune out dead branches is supremely superfluous; but the mere fact that the blight is caused by bacteria does not militate against methods which have been considered valuable when the disease was supposed to be of a fungoid nature. The practice of coating trees, as far as can be done conveniently, with a lime wash containing sulphur has been frequently indorsed as a wise precaution by those who have tried it. It is asserted that no part of a pear tree covered with this wash has ever been attacked by blight. On the other hand, the opinion is held by those who have studied the bacteria, that they enter into the tree only by the tender buds, or at very soft, moist, succulent parts, and that they never attack the bark of the branches or trunk; hence, it is argued, lime covering of these

annot have any effect whatever in preventing bacteria from in-
t tree and causing blight.

may seem sufficiently conclusive from a certain standpoint; at
time it is not unusual to find blight on the stem or trunk of a
e there are no tender buds or flowers for bacteria to enter, and
e found some means of entrance; but it is proved so far

that no blight has been perceived on any portion of a tree that is protected by a coating of the lime mixture.

It is conceded that the best remedy for the destruction of bacteria or of fungi on plants is sulphur, and when it is mixed with lime and applied to the bark it forms a mechanical covering impenetrable to bacteria, and when acted upon by sun-heat, sulphurous gases are evolved to such extent that the sulphury smell is perceptible to those who walk through an orchard on a sunny day where the application has recently been made.

I do not know of anything that offers more successful results, remedial or preventive, or that will be more likely to be effectual in arresting or preventing the cause of blight on fruit trees than this application of lime and sulphur. It has been used more or less for the past twenty years, and has been reported upon favorably by those who have used it. The following is the method of preparing the wash: Take one-half bushel of lime and place it in a barrel, then add about 8 pounds of [illegible] sulphur and cover with boiling water in sufficient quantity to [illegible] slake the lime, the mouth of the barrel being covered until ebullition ceases, when it should be thoroughly stirred and more water added if the mixture appears solid. When used, it is diluted with water until it is of the ordinary consistency of common whitewash. All parts of the tree that can be reached should be brushed over with this wash, and if the white color is objectionable it can be darkened with lamp-black to the desired shade of color. To destroy mildew on plants, such as attack grapes, roses, &c., the barrel containing the mixture should be filled up with water, and, when settled, a pint of the clear sulphur water should be used in 4 or 5 gallons of pure water, and the plants syringed with the mixture. There is no better or simpler mixture than this for the destruction of mildew on plants, nor anything which we have tried that proves so effectual.

The fruit of some varieties of the pear are greatly injured by splitting or cracking open when about half grown; indeed, one of the very best known pears, the White Doyenne, has been almost thrown out of cultivation on account of this disease, and several other first-class varieties such as Beurre Giffard, Sheldon, and Flemish Beauty, are so [illegible] this malady that their extension and planting in orchards is greatly restricted on that account. The cause and prevention of this injury to these valuable fruits have long been matters of serious study; the popular conclusion that the disease resulted from a deficiency of [illegible] particular element in the soil was early advanced, but as authorities [illegible] in their recommendations in regard to the special ingredient required and as no good results followed the application of any of the proposed remedies, the only alternative which seemed satisfactory to fruit-growers was that of abandoning the culture of varieties specially subject to the injury. The cause seems to be climatic, and the disease is therefore unlikely to be affected in any way by the nature of the soil or by any system of culture or any special application to the soil. The cracking is the consequence of a fungus growth upon the tender skin of the fruit which apparently destroys its vitality, as it becomes hard and unyielding; and as the fruit expands and increases in size, the injured skin being too hard for expansion, cracks open. This is the usual result with fruits injured by mildew, and the same effects may be seen in the mildewed berries, grapes, and gooseberries.

To say that this cracking of the pear is primarily caused by climatic influences seems a rather vague and indefinite reason, as we all [illegible] the particular conditions of climate which promote

growth of the fungus; we only know that shelter and protection will prevent it, and of this we have seen many proofs, both incidental and experimental. It is not unusual to find in fruit exhibitions in cities samples of the White Doyenne pears as fine and as free from cracking as any variety that could be named; these fruits have been gathered from trees growing in sheltered city yards which have received no special care or indeed culture of any kind.

Several experiments have been recorded which tend to prove that the cause is climatic; of these may be mentioned that of a dwarf tree of the White Doyenne, which produced abundantly of cracked fruit when in the open garden, but which, when removed and planted in a box in a cool greenhouse, ripened perfect, smooth-skinned, fine fruit. Another is that of a grower who had a row of dwarf pear trees of this variety which produced worthless, cracked fruit; of these, two were partially inclosed by glazed hot-bed sashes, four of which were set on end around the tree, thus forming a square inclosure open at top; these were elevated about 18 inches from the surface of the ground, so as to include the larger portion of the top of the trees. Trees thus protected produced fruit perfectly free from any symptoms of cracking, while contiguous trees were so badly attacked as to produce comparatively worthless fruit. This experiment was repeated for several years, each year the sashes being removed and placed on different trees, and always with the same result, the protected trees yielding perfect fruit, while those not protected were all more or less injured by cracking.

These observations and experiments prove that the cause of the cracking of the pear is climatic, and that the culture of the soil, or, so far as is at present known, applications to the soil, have no effect whatever in preventing this disease.

THE ROT OF THE POTATO.

potato rot is caused by a fungus, *Peronospora infestans*. This is y allied to the grape-leaf mildew, *Peronospora viticola*, and is un- lly f ed by similar atmospherical conditions.

m w of the potato first attacks the foliage of the plant, form- on the under side of the leaves, and, under favorable condi- dly and in a short time reaches the stems, the fun- ng down through them to the tubers, which soon com-

planted on flat, low-lying lands, they will soon cover thick, heavy mass of stems and leaves, and when they become saturated with water, and their mas- the complete evaporation of moisture during the day, as long as dews prevail, they never become thoroughly dry. conditions will occur during a period of dull and rainy Under these circumstances the fungus grows rapidly, and if it speedily destroys the crop.

rot will pear even on dry lands, if they are sufficiently rich to growth, and the situation low. On hill-sides the rot is , because in these positions dews are not so prevalent, all times slight, compared with the heavier dews in valleys; quickly evaporated on hill-sides, owing to the better ex- and to the movements of the air, just as grape culture is d the liability to mildew reduced to a minimum, on ele-

deductions proceeding from the above considerations

will be, first, to select, when practicable, somewhat elevated fields for potatoes, and where such specially favorable selections are not available, to plant in drills so widely apart that a clear space will be left between the rows, so as to guard against the production of a dense covering of foliage over the entire surface, and permit a free circulation of air through and among the plants.

WILLIAM SAUNDERS,
Horticulturist, Pomologist, Landscape Gardener,
and Superintendent of Gardens and Grounds.

Hon. NORMAN J. COLMAN, *Commissioner.*

REPORT OF CHIEF OF SEED DIVISION.

SIR: The distribution of seeds in accordance with the act of Congress, May 15, 1862, establishing the Department of Agriculture, has grown e a business of the greatest practical importance to the agriculture he nation. Prior to January 1, 1863, there were distributed to mem- of Congress and other persons throughout the Union 306,304 pack- f garden and field seeds. Since that time, the number which has t out annually has gradually increased, so that the amount ted last year nearly 4,000,000 packages. The seeds, which are ny purchased by the Commissioner of the most reliable seedsmen growers of seed throughout this and foreign countries, are, after g efully tested, put up in small packages under the immediate of the superintendent of the seed division, and are then to distribution authorized by act of Congress.

am nt appropriated for the purchase and distribution of seeds p nts for the fiscal year ending June 30, 1885, was $100,000. Large his amount may seem to the casual reader, it is not sufficient to ly remunerate the statistical correspondents, were a fair price them for the labor they perform. The Agricultural Depart- nas a principal crop correspondent with three assistants in every ty, and general statistical agent in each State. The number of s it to the county correspondents during the fiscal year r n to was 412,609, while the State correspondents received al record is kept in the offices of the chief clerk and of seed division of each package, when, and to whom present law in regard to the method of distribution re- an equal proportion of two-thirds of all the seeds, plants, cuttings shall, upon the request of Senators and Representatives Delegates in Congress, be supplied to them for distribution among agricultural constituents, and the person receiving such seed shall rm the Department of the results of their experiments therewith." nion, no seeds ought to be distributed where the object is to e th t ed without requiring a written report from the person ving m. I would earnestly recommend, where special reports the seeds and plants be distributed in sufficient quan- s to enable the recipients to make a thorough test of their value; where seeds are sent with the view of having such tests made, ould be sent to the most intelligent, painstaking farmers, who only know how to observe facts, but how to keep a correct record

The ol the governmental distribution of garden, field, may be briefly summarized as follows:

1. rits of new and valuable plants in different localities s.

2. To thereby increase the annual average yield by the use of well- y ripened, perfect seed.

To promote the best interests of all classes, in whatever industrial

pursuit they may be engaged, by an increased improvement in bot quantity and quality of agricultural products.

It is a fact that in the equitable interchange of seeds and plant which has taken place between our own Government and those of foi eign countries our friendly relations therewith have been greatl strengthened and promoted. In no department of the General Govern ment has the expenditure of so small a sum been so productive of a much good as that expended in the introduction and dissemination c valuable seeds and plants. There are the most ample statistical data a hand in the carefully-kept records of the Agricultural Department t show that the increased production of wheat, oats, and other cereal and grasses, has, by reason of the wide distribution of improved var eties, paid tenfold the entire amount expended by the Department c Agriculture since it was established.

The charges that are occasionally heard of the distribution of worth less and common seeds, have, in the main, no substantial foundation i fact. They originate in many cases from carelessness in the time o method of planting, and in others in the pecuniarily-biased imagina tions of writers. With the present method of applying a double test t ascertain the exact per cent. of the vitality of the seeds now sent ou from the seed division, the fault cannot be rightfully attributed to in perfect seed. The complaints that the seeds sent out are improperl labeled, and are not true to name, may be, and probably is, a just on in exceptional cases, for in putting up so many million papers of se it would be very strange if no mistakes were ever made. The impor tance, however, of disseminating seed of the best pedigree as widely a possible cannot be too strongly insisted upon by those who earn th bread by the sweat of their own brows.

SEED IMPROVEMENT.

That the subject of seed improvement has been too much neglecte in the past, by progressive farmers, is a fact which all will admit. How ever, with the increasing intelligence of the farming community, ver many thinking, working farmers have been forced to acknowledge th need of more accurate information on the subject of seed-breeding b means of crossing or hybridization. It is a subject not less in importanc than the production of thoroughbred stock by such crosses and inte mixture of blood as will tend to perfect development in the line of objects sought to be attained. It is upon the recognition of this fac that I have, in the following paragraphs, endeavored to compile, fro the most authentic sources, a series of facts bearing upon the subject c seed-breeding, with the view of inciting a still deeper and more abidin interest in the most practical methods of

CROSSING OR HYBRIDIZATION.

The leading principle involved in seed improvement is that known a hybridization. In order to generate the best kinds of seeds, the mos healthy plants must be chosen, and those which are the most early i respect to season should be so insulated as to have no weak plants c the same species, or even genus, in their vicinity, lest the pollen of th weaker plants should be blown upon the stigmata of the stronger an produce a less vigorous progeny.

In the majority of cultivated plants the two sets of organs, the pi l and stamens, are in the same flower. In some plants the pistils and t

stamens are in different flowers. In cucumbers, melons, and all of that family, they are in different flowers on the same plant. Sometimes the two kinds of flowers are borne by separate plants, as in the beet. In a perfect flower the usual arrangement is for the pistils to occupy the center, and to be surrounded by the stamens. The parts most intimately concerned in the production of a seed are the ovule and the pollen, the one to be fertilized and the other the fertilizing agent.

"Crossing or hybridizing," says Thomas Meehan, editor of the Gardener's Monthly, "is a very simple process. We take the pollen dust from one flower and place it on the apex of the pistil of another. To make sure that the flower you wish to raise the seed from does not get its own pollen, it is best to open the flower before it naturally expands and cut off its antlers before they have a chance to throw out their pollen. At the same time it is best to put the pollen of the male parent at once on the stigma. The stigma is usually not receptive, that is, has not the liquid exudation necessary for the effective reception of the pollen at this early stage, but it remains on the stigma ready for use when the stigma is ready to receive it. These precautions are necessary in order that we may be sure the flower receives only the pollen we desire it to receive. Some cover the flower after the antlers have been removed, until the time for the use of the pollen has arrived, with gauze to keep off insects that might bring other pollen, but this is scarcely necessary when done in the way suggested."

POLLEN.

"Pollen," says Gray, who is the highest authority in botanical matters, "is the product of the anther, and is usually a powdery substance which, when magnified, is seen to consist of separate grains of definite size and shape, uniform in the same plant, but often very different in different species or families. The grains are commonly single cells, globular or oval in shape, and of a yellow color. Pollen grains are usually formed in fours, by the division of the living contents of mother-cells first into two, and these again into two parts, which become specialized cells. As the pollen completes its growth the walls of the mother-cells are usually obliterated. A pollen has two coats. The outer coat is comparatively thick, and often granular or fleshy. This is later formed than the inner, and by a kind of secretion from it; to it all the markings belong. The inner coat, which is the proper cell wall, is a very thin, delicate, transparent, and colorless membrane of considerable strength for its thickness.

"The cavity inclosed by the coats is filled with a viscid substance, which often appears slightly turbid under the higher powers of ordinary microscopes, and, when submitted to a magnifying power of about 300 diameters, is found to contain a multitude of minute particles, the larger of which are from one four-thousandth to one five-thousandth of an inch in length, and the smaller only one-fourth or one-sixth of this size. When wetted, the grains of pollen promptly imbibe water by en-
s, and are distended, changing their shape somewhat, and ob-
g the longitudinal folds, one or more in number, which many
exhibit in the dry state. Soon the more extensible and elastic
c inclines to force its way through the weaker parts of the
pecially at one or more thin points or pores, sometimes forming
ions when the absorbtion is slow and the exterior coating tough.
y kinds of pollen the grains, when immersed in water, soon dis-
bursting, discharging their contents.

"In others, and in most fresh pollen, when placed in ordinary aerat water, at least when this is slightly thickened by sirup or the like, a submitted to a congenial temperature, a projection of the inner c through the outer appears at some point, and by a kind of germi grows into a slender tube, which may even attain to three humdr times the diameter of the grain, and the richer protoplasmic conten tend to accumulate at the farther and somewhat enlarging extremi of this pollen tube.

"Commonly the pollen remains unaltered until it is placed upon t stigma. The more or less viscid moisture of this incites a simil growth, and also doubtless nourishes it, and the protruding tube at on penetrates the stigma, and by gliding between its loose cells buries self in the tissue of the style, descending thence to the interior of t ovary and at length to the ovules. Fertilization is accomplished by action of this pollen upon the ovule, and upon a special formati within it. Consequent upon this an embryo is formed, and the ov now becomes a seed.

"Hybridization at the present time is only done by fresh pollen—grains (cereals) and in potatoes.

"Pollen contains much nitrogen and phosphorus, the two most preci of all the elements for the growth of plants, but in the case of most op flowers a large quantity of pollen is consumed by pollen-devouring i sects and a large quantity is destroyed during long-continued rains. order to compensate the loss of pollen in so many ways, the anthe produce a far larger amount than is necessary for the fertilization the same flower."

SAVING POLLEN.

"The improvement of races of plants is not destined to stand still, m than in the case of other improvements," says the *Horticultural Revie* "and nothing would tend more to the speedy termination of an expe ment than that we had control over the supply of pollen, so that might use it when and where convenient to ourselves. We have h reports of failures in trying to keep a harvest pollen, from Austral India, North America, and from many people in this country, but fr none of them have we heard one word about the process of ripening a drying the pollen. Pollen fifty years old, in a herbarium, was foun under a microscope, to yield to moisture exactly as fresh-gathered p len would do, the little bags distending till they burst; the matter d charged differed in no way from that of a recent anther.

"Failures in saving pollen arise from want of thought. If the anthe become ripe or near to ripeness they will open during the process drying, and we might just as well attempt to lock up electricity as secure the pollen grain from destruction. All that we have actua proved on the subject is this, that if we extract the anthers and stame ng before the anthers are ripe, the pollen in them will ripen and be se and fit to cross after the lapse of six months, while pollen gather len ripe and flying out of the anthers, though kept with the greate re, would not fertilize the stigma of the parent plant at the end o nth.

"We believe the driest atmosphere we can keep in our rooms a awers is far too moist for the preservation of pollen for any length me after being actually exposed to it; and we also believe that ther would keep as long as a bladder under the same influences, a hat it is as impervious to moisture as the bladder, and therefore as

pable of preserving pollen as is the seed-vessel of the fern of retaining the vitality of the seed—a fact that no one now questions."

Papilionaceous flowers—those of plants of the leguminous order, as the pea, so called from the butterfly-shape of their flowers—offer innumerable adaptations for cross-fertilization. "The stamens of the *Posoqueria fragrans* (one of the Rubiaceæ)," says Fritz Muller, in the *Botanische Zeitung*, "are irritable, so that as soon as a moth visits a flower the anthers explode and cover the insect with pollen. One of the filaments, which is broader than the others, then moves and closes the flower for about twelve hours, after which time it resumes its original position. Thus the stigma cannot be fertilized by pollen from the same flower, but only by that brought by a moth from some other flower. Endless other beautiful contrivances for this purpose could be specified."

CROSS AND SELF FERTILIZATION OF PLANTS.

In the compilation of facts relative to the effects of cross and self fertilization of plants, so far as it relates to seed production, I am largely indebted to the latest work of Charles Darwin upon the subject. His investigations have done much toward the solution of many of the most puzzling questions relating to interbreeding and self-fertilization. He has shown most conclusively that plants bearing hermaphrodite flowers can be interbred more closely than is possible with bisexual annuals, and are therefore well fitted to throw light on the nature and extent of the good effects of crossing and on the evil effects of close interbreeding and self-fertilization. Or, in other words, "a crossed plant, seedling, or seed means one of crossed parentage; that is, one derived from a flower fertilized with pollen from a distinct plant of the same species; and that a self-fertilized plant, seedling, or seed means one of self-fertilized parentage; that is, one derived from a flower fertilized with pollen from the s flower, or sometimes, when thus stated, from another flower plant."

conclusion arrived at through the most careful and painstaking ob ions, extending over a period of many years, is that cross-fertiliz n is generally beneficial and self-fertilization injurious. This, in experiments referred to, was shown, not only by the "difference in t, weight, constitutional vigor, and fertility of the offspring from c and self-fertilized flowers, but also in the number of seeds proby the parent plants. This cannot be attributed to the superiority of crossed, but to the inferiority of the self-fertilized seedlings, due to the injurious effects of self-fertilization." "Whether the evil from self- ion goes on increasing during successive generations is not as wn, but we may infer from my experiments that the increase, , is far from rapid. After plants have been propagated by self-fertu ion for several generations, a single cross with a fresh stock ores their pristine vigor, and we have a strictly analagous result n our domestic animals. The good results of cross-fertilization are tra tted by plants to the next generation, and, judging from the on of the common pea, to many succeeding generations. But y merely be that crossed plants of the first generation are exy vigorous, and transmit their vigor, like any other character, to successors."

vin claims with characteristic positiveness that the "advantages ertilization do not follow from some mysterious virtue in the on of two distinct individuals, but from such individuals having jected during previous generations to different conditions or to

their having varied in a manner commonly called spontaneous, s
in either case their sexual elements have in some degree been dif
tiated. And, secondly, that the injury from self-fertilization f
from the want of such differentiation in the sexual elements."]
further remarks "that the advantages of cross-fertilization depe
the sexual elements of the parents having in some degree becon
ferentiated by the exposure of their progenitors to different condi
or from their having intercrossed with individuals thus expos
lastly, from what we call in our ignorance spontaneous variation."
therefore, who wishes to pair closely related animals ought to keep
under conditions as different as possible. Some few breeders, g
by their keen powers of observation, have acted on this princip
have kept stocks of the same animals at two or more distant ar
ferently situated farms. This same plan is also unconsciously fol
whenever the males, reared in one place, are let out for propagat
breeders in other places. As some kinds of plants suffer much
from self-fertilization than do others, so it probably is with ar
from too close interbreeding. The effects of close interbreeding o
mals, judging again from plants, would be deterioration in g
vigor, including fertility, with no necessary loss of excellence of
and this seems to be the usual result. It is, Darwin says, "a co
practice with horticulturists to obtain seeds from another place h
a very different soil, so as to avoid raising plants for a long succ
of generations under the same conditions; but with all the s
which freely intercross by the aid of insects or the wind, it wo
an incomparably better plan to obtain seeds of the required va
which have been raised for some generations under as different cond
as possible and sow them in alternate rows with seeds matured
old garden. The two stocks would then intercross, with a tho
blending of their whole organizations and with no loss of pu
the variety, and this would yield far more favorable results t
mere exchange of seeds."

Such are the conclusions arrived at by the distinguished scient
ferred to. It will be seen that the practice of procuring fresh
from foreign countries and remote localities in our own country, l
Commissioner of Agriculture, for subsequent distribution, is one
is in full accord with the best attainable light upon this importan
ject.

PRODUCTION OF NEW VARIETIES OF WHEAT BY CROSS-FEC TION.

The improvement of agricultural plants by cross-fecundation is
ject of the highest importance. It is quite as feasible as the hy
ing or cross-breeding in animals. It often involves, however
extensive inquiry, and when applied to the production of new va
of wheat, the interests of the farmer, the miller, the baker, ar
consumer are all to be duly considered.

In addition to what has been given on this subject, it may be state
u performing the operation it is not only necessary to guard a
he fertilization of the ovary from its own anthers, but that it is
ite that all the other anthers of the same ear, above the ovaries
ially fertilized, should be extracted; otherwise they would pour
contents of their pearly globules to the relief of the feathery st
nd disappoint the experimenter's hopes. For more than ordinar
s taken by nature that the grass tribe, which includes wheat, sl

fertilized by its own pollen. An opinion has long prevailed that wet weather injures the grain while it is in blossom. This opinion is erroneous, inasmuch as, in wet and very hot weather, fertilization is carried on within the chaff. "Often in moist weather," says Mr. Maunde, of London, England, "have I felt much interested when, wanting pollen, I have held the straw and bottom of the ear in my warm hand for two or three minutes, watching for a crop of anthers. Quickly the ripest of them, stimulated by the warmth, would peep out from their seclusion, and, gently rising, give me a chance of capturing them ere they scattered their contents over the expectants beneath them. Sometimes, on leaving these excited ears and returning to them after 10 or 15 minutes, I have found several anther-cases as empty as balloons, dancing to the breeze, as if joyous that in my absence they had scattered every pearl they possessed."

In regard to wheat improvement, Prof. A. E. Blount, of the State Agricultural College of Colorado, says:

There are many ways of running wheat out. Wheat after wheat in the same soil, without any regard to rotation; using seed taken from the common bin or elevator, without its being selected before thrashing; sowing imperfect shriveled grain, and sowing the seed too late, all tend to degrade wheat and run it out. Soil run in wheat year after year not only loses its elements for producing a valuable milling variety, but the grain itself suffers a rapid decline. By non-selection and permitting a foul and foreign seed to become mixed with them, our best wheats deteriorate as rapidly as people densely packed in the poor quarters of the city.

The system I have adopted in improving and making better kinds is as follows:

(1) Procure the best standard varieties from all sections, generally from the producers.

(2) Sow at different times, and from the earliest ripe of the first crop select only the best for seed the next year. It is not difficult to tell how a foreign wheat will succeed after the first crop ripens, nor is it a difficult matter to select the best to sow again. All that is necessary is observation and some patience.

(3) Cross in line, of the first crop, the best samples—one or two grains in each head—always using the stiffest straw and the most compact head as the mother plant. Crossing is comparatively an easy operation. The time to do the crossing is quite difficult to fix; it can be learned only by experience. Crossing varieties that have the same or nearly the same characteristics, not elements, produces much more valuable results than using those of diverse peculiarities. "Out of line," as in stock breeding, the "blood runs zigzag and crooked," generally producing scrubs in plants as well as animals. For instance, smooth white varieties should be used one upon the other, bearded upon bearded, &c. Smooth and bearded white and red wheats can be crossed upon one another, but the selection of a valuable cross from the offspring is a work that has but little value. The offspring will be as varied as a brood of chickens found following a hen whose parentage is of all the breeds. If the "Australian" should be crossed upon the "Defiance," some of the grain would resemble the "Australian" and partake of its nature, some the "Defiance," while others would be "sports," or grain partaking of the characteristics and elements of both mixed up. Among these "sports" are found the best specimens to be bred up by selection. It requires three years—sometimes more—"to fix" a wheat (free from its tendency to sport) or to make it a fixed standard that will not deviate from the course it has adopted. Selection only improves, crossing changes the qualities.

By way of improving wheats my work has been directed upon over 300 varieties of seed obtained from almost every wheat-producing country in the world. Not a single sample received but has greatly improved by being raised here. All have improved in appearance, yield, and color, and over three-fourths in milling elements. So great has been the change for the better in most of them that the product bears but little resemblance to the seed received. The chemist, Clifford Richardson, at Washington, has analyzed 84 varieties of these wheats; in 1881, 33 kinds; 1882, the same and 15 more, and in 1883–'84 the same with 36 new kinds. He says: "Among the individual States Colorado wheats are certainly the best which have been produced in this country." (Report for 1882.) In his last analysis the milling elements have so improved that ...ats Colorado wheats first of all in the world for good flour.

...ddition to the report of the chemist, Colorado enjoys the reputation of produc... for the past seven years, by 3 to 5 bushels' average, per acre, than any other ...ountry, and of having taken more first premiums.

IMPROVEMENT BY SELECTION.

The selection of the best for seed, or the rejection of the poorest, ha always been, strictly speaking, the only method of improving varietie The careful selection of seed was recommended in early times. Columell and Celsus and Virgil speak of it. Improvement by selection is we known in the abstract, but it cannot be too often brought forward an urged anew.

Some seed-wheat of a choice kind, weighing 58 pounds per bushe was improved by careful selection and treatment until an entire crop, i a few years, averaged 63 pounds per bushel. Every year the best fiel was chosen for seed, the seed-wheat extra cleaned by fanning-mill t blow out the lighter grains, then hand-sifted to get out the smalle grains, then the imperfect grains skimmed from the surface of the stron brine in which it was put as a preventive of smut; thus only the larg plumpest, heaviest grains were sown. That the soil alone did not pr duce this change was shown by the fact that it took several years t bring the improvement about; and that then the improvement wa shown when used on other farms.

Dr. E. L. Sturtevant, director of the New York experimental statio in speaking of the importance of the careful selection and change c seed, says:

> Improve the character of the seed supply, either through selection or by change c seed. At the New York station, in 1885, one variety of oats averaged over 30 bushel per acre more than another, and frequent illustrations could be given of the doublin of crops as between varieties, one better adapted to our conditions than another, o else from differences inherent in the variety. The problem for experimental actio can then be the question as to what constitutes this difference of potency in the seed and in what way and to what extent can it be brought under our control, and wha are its relations to climate, fertility, and culture.

DIFFERENCES IN THE SEEDS OF THE SAME PLANT.

Mr. Frederic F. Hallett, of Brighton, some thirty years ago bega systematic experiments on improving wheat. A single head, chosen fo fine quality, irrespective of size or vigor, was 4¾ inches long and ha 47 grains. These grains were carefully planted in rows, one seed in place, 12 inches apart each way. At harvest the plants were com pared, the best head of this best plant planted the next year in the sa way, and so on year after year, each year choosing the best head fro the most prolific plant. The first year the best plant bore 10 heads the second year 22, the third year 39, and the fourth year 52, the b head of which was 8¾ inches long, and bore 123 grains. This was t origin of the famous "Pedigree" wheat. He gave the name "Pe gree" because the process of improvement by selection was precisel analogous to that of breeding animals to points and strengthening th eredity of the good points by "pedigree." His riper conclusions, give ater (in the Trans. Brit. Assoc. Adv. Sci., 1869, p. 113), are that ever fully-developed plant, whether of wheat, oats, or barley, has one ea superior in reproductive power to any of the others on the plant; tha every such plant has one grain more productive than any other, an that this best grain grows on the best ear; that the superior vigor o his grain is transmissible to its progeny; that by selection this superio ty accumulates; that the improvement is at first very rapid, but tha n successive years it gradually grows less; that an improved type i he result, and that by careful selection the improvement can be kep t. Experiments conducted by Dr. Gustave Marck at the experi

stations at Halle and at Leipsic, Germany, go to show that a larger, better, and more uniform growth is obtained from large seeds. The superiority is shown in tables of results, in every particular, in height, luxuriance of growth, uniformity, aggregate weight, number of pods, number of seeds produced, weight of seeds, quality of crops; in fact every desirable characteristic was in favor of the larger seeds. Professor Lebemann, of Munich, Bavaria, has the same results. As to the opinion of many farmers that grains of Indian corn selected from the middle of the ear are better for planting, I am unable to refer to any exact experiments on the subject.

It is easier to deteriorate a crop by choosing bad seed, or even by carelessly neglecting the selection of good, than it is to improve an already good variety.

Prof. James Buckman, of the Royal Agricultural College, has experimented with the seed of malformed and misshapen crop-roots (Trans. Brit. Assoc. Adv. Sci., 1862, p. 97). He found that when seeds derived from misshapen turnips and parsnips were used they produced even greater deformities than the parents presented. His conclusions are as follows:

A degenerate progeny will, as a rule, result from the employment of seed from badly-grown roots, and, besides, the degenerate seed does not produce nearly so large a crop; and that, by selection, we may produce roots well shaped, and increase the probabilities of producing the best crop. Darwin (Animals and Plants under Domestication, 11, 243) cites his authorities for saying that in France, since the cultivation of beets for sugar, the plant has almost exactly doubled its yield of sugar, and this has been effected by careful and systematic selection, the specific gravity of the roots being tested and the best roots saved for seed.

IMPROVEMENT BY SELECTION AND CULTIVATION.

"Improvement by selection is adding up, from generation to generation, any special character. Sometimes the character itself, when pushed to excess, becomes a defect. When any variety has been improved up to a certain stage by selection, we reach a point beyond which any further change in that direction is no longer an improvement; then we must use selection to maintain the excellence already achieved.

"Only the well-developed and fully-matured seed should be used, and the permanent "seed-patch" should be kept up to its original standard of excellence by an ample supply of fertilizers, domestic and, if need be, commercial, for it is necessary to give to the parent-stock such a quantity of nutritious food as will keep it in good condition and impart to it that healthful vigor so essential to successful propagation. The seed-patch and "annual selection" should be handed down by the farmer to his posterity as an inheritance more valuable than evanescent gold."

IMPROVEMENT OF SORGHUM SEED.

Prof. Swenson, of Ottawa, Kans., in an interesting communication ... Farm's Rural World, in the issue of November 5, 1885, says:

Speaking from my own limited experience, I am certain that the sorghum cane is ... of very great improvement. Last year I had a 40-acre field of cane, the ... which contained an average of 15½ per cent. of cane sugar and but three-... cent. of glucose, and this was almost entirely due to thorough cultivation ... selection of seed. We had yields of cane this year, planted from the same ... and a ton of one would be worth double that of a ton from the other. ... was all due to difference in cultivation, and it seems to me that this

is a very inviting field, and I trust it will be thoroughly investigated. I hav that a few years of intelligent work of this kind will put us in possessio that will take the front rank among sugar-yielding plants.

In a letter of a later date Professor Swenson maps out th line for work, as follows:

(1) To increase the amount of cane sugar in the cane and diminish the of other soluble solids; (2) to obtain a variety of cane that will ripen *ear* give the factories an early start; and (3) to increase the size of the stalk, to resist storms, and increase the yield.

THE VITALITY OF SEEDS.

"The vitality of seeds is determined by the length of time re disorganize them, as kept under ordinary circumstances. W as to dryness, and partial exemption from the effects of the o the air, seeds remain vital for twice or three times the number given in the table. Kept entirely from contact with the air an ure there is practically no limit to the length of time they may intact. As to the amount of cold which the seeds of plants w stand without impairing their vitality, if dry, there is pract limit. More than twenty years ago a test of seeds submitted t of liquid sulphuric acid, rendered as cold as possible by artificia showed that the germ was not destroyed by the process. Wh out and sown in pots in the open air, they all germinated. Tho had been submitted to the severest cold germinated as readily a as good and healthy plants as those not submitted to this extre

Wheat and other cereal grains, if not injured by insects or d tain their vitality perfectly three or four years, but seeds of the year's growth are best. Grass seeds should not be depended more than one year. The proper rule to be kept in view in th of all seeds for great lengths of time is, first, perfect dryness, a perature of not less than 100° nor more than 130°, then packed bags, inclosed in canvas sacks, and kept as near the freezing possible, and at the same time in a dry atmosphere.

Many years ago Cobbett, in England, experimented quite la determining the duration of vitality in different seeds. Cons later Vilmorin, in France, experimented in the same direction. sults of the two varied widely, so widely, indeed, that the plan safe had best be governed by the lesser figures, except, pos case of the melon family, the seeds of which are not so good pr the fourth year as afterwards. We give the two lists as establ these experimenters:

Variety.	Cobbett.	Vilmorin.	Variety.	Cobbet
	Years.	*Years.*		*Years.*
Artichokes	3	5	Kale	
Asparagus	4	4	Leek	
Bean	2	6	Lettuce	
Bean (kidney)	1	3	Melon	1
Beet	10	5	Onion	
Broccoli	4	5	Okra	
Cabbage	4	5	Pea	
Carrot	1	4	Pumpkin	1
Cauliflower	4	5	Radish	
Celery	10	.....	Salsify	
Corn	3	2	Spinach	
Cucumber	10	5	Squash	1
Egg Plant	3	.....	Tomato	
Endive	4	9	Turnip	

The best of seeds, shabbily treated, are liable to fail. Much wet, cold weather will prove fatal to some, while others will go right on; moderate drought will destroy the germs of some, while others will withstand a protracted one. For instance, the experience of all gardeners is that seed germs of cucumbers, squashes, melons of all kinds, lima beans, sweet corn, and wrinkled peas cannot survive protracted, cold, wet weather, while those of the carrot, beet, onion, turnip, lettuce, and salsify will withstand the trial a great deal longer.

The careless or inexperienced may plant too deep or too shallow, and the aim of the man, woman, or child, who is to run a farmer's garden, should be to inform himself regarding the characteristics of different seeds in this respect, so that bad results shall not follow.

A committee of the British Association expended much time and money in making a fair and thorough research as to the age at which seeds would grow, and published the result of their work. It was shown that less than half of the corn three years old sprouted; millet seed, less than half; oats at three years were about three-fourths good, and at eight less than one-sixth; wheat at three years a little over half, and at eight and nine years did not grow at all; rye at three years practically none; barley at three years from one-half to two-thirds, but at eight and upwards did not germinate. It is unnecessary to say that these experiments can be entirely relied upon. The seeds were carefully kept in waxed cloth and in sealed jars.

On the other hand, Messrs. Tiegham and Gaston Bennier say that of a hundred peas preserved in the free air ninety afterward germinated; of a hundred inclosed with air in a sealed tube, only forty-five; while of a lot kept in carbonic acid gas none grew. Similar results were obtained with other seeds, showing clearly that all seeds should be stored where pure air may have full access to them. This difference of opinion shows that there is still a wide field for experiment.

GERMINATION OF SEEDS.

In 1860, a noted seedsman of Erfurt, France, M. Appelius, made the following statements regarding the germination of seeds:

The method of testing a sample of seeds by their specific weight and density is good, but not infallible. It may frequently mislead, particularly in the case of seeds whose specific gravity differs little from that of water. For example, those cucurbitaceous plants which are produced during cold seasons float upon the water and nevertheless germinate very well. Good seeds of the melon and gourd lose weight as they grow old without becoming bad. We conclude, therefore, in this case as in many others, that trial by water is not a sure test. The specific gravity of oily seed is often nearly the same as that of water, although in some cases heavier, as cabbage, for example. The lightest seeds are those of umbelliferous plants, such as carrots, parsnips, anise, &c., and of composites, such as lettuces, scorzoneras, &c. In the first of these families the lightness of the seeds arises from the presence of an oil in the case which incloses the seed, and of air in the last.

The test of heat and moisture, 59° to 75° F., is convenient and tolerably sure for clover, peas, and the cereals, but does not answer for those which require a long time to germinate. For these the best practical plan is to grow a sample in a pot. Even this will not always give a strictly correct indication of the germinating power of seeds, since the result depends, all other circumstances being equal, upon the care n in sowing, the temperature of the air, the depth at which seed is sown, and ime of year, &c. Thus, the pips of apples and pears almost always germinate when the trial is made in pots soon after they are ripe, whilst they answer perif they are sown at the end of October or March in beds in the open air. For son it often happens that a sample is pronounced bad when in reality it is ex- Soil that is used to cover the trial seedlings also considerably affects the If rye-grass seed is sown in soil which retains moisture with average tenacity, mried 1 inch below the surface, seven-eighths of it grows in twelve days and bly fewer seeds geminate and require a longer period of time for it accord-

ing to depth of planting, until at 6 inches the proportion is reduced to one-eighth the quantity sown in twenty-three days.

On the other hand, when rye grass is sown and simply harrowed in, it germinat without exception in five days. A tolerably large number of seeds come up slowl and even with difficulty; they are generally those which have a thick, tough ski In this case it is a good plan to soak the sample in hot water, 167° to 185° F., f twenty-four hours. Notching, if performed with care, so as not to injure the embry assists germination. Planted in the usual way, such seeds will lie dormant one or tv years. Seeds of the palm usually grow very well on damp sawdust, the germinati end downwards and kept in a damp, warm atmosphere. The spores of ferns and t seeds of orchids, which are very minute, come up rapidly if placed on peat in a pan water.

The frequent failure of garden seeds may be ascribed to too deep planting in a s too dry. Perfectly hardy annuals are best sown late in the autumn or very early the spring.

Want of success with seeds may be oftener attributed to bad management than to b seeds. The success of seedlings raised under frames depends principally upon t regulation of moisture.

It is known, too, that the seeds of these plants bear more female flowers than young plants, that is to say, the plants are more prolific than those raised from seeds ; ered in a cold season and planted shortly after they have ripened. Good seeds o melon and gourd lose weight as they grow old; at first they will sink in water a by the sixth year half of them will float without having become bad. We conclud therefore, in this case as in many others, that trial by water is not a sure test.

SUBSTANCES AFFECTING THE GERMINATION.

M. Vogel, of the Bavarian Academy of Sciences, found that a min mum of carbolic acid was sufficient to kill every trace of germinatio He says:

Among those most injurious in this respect are dilute acetic acid and carbolic aci although the substances may be present in very small percentage. Solutions of h drocyanic acid, arsenic, phosphorus, &c., were found to be much less injurious in t same proportion than those first mentioned. This explains the unsatisfactory natu of experiments for the destruction of insects on plants by means of solutions of c ol acid, the insects, it is true, being killed by a very weak solution, while at the time the plants themselves rarely survive.

CHANGING SEED.

In the issue of the *Corn Miller* of March 5, 1885, I find the followin pertinent suggestions:

Changing seed has long been practiced by farmers with excellent results, it of being attended with a largely increased crop. All farmers are acquainted with fact that if some kinds of seed are not changed the crop will soon run out. Th fact is true of grains, but applies to a larger extent to garden vegetables. For i stance, the onion seed of Connecticut is imported from Tripoli and grows well the for one or two crops, but if the cultivation is long continued from the original see the onions soon are only of the size of acorns. Again, potatoes grow well in Louis ana, and as far south as the Bermudas, if the seed is taken there from a cool clima each year. Heavy oats, taken from the cool, moist climate of Canada and Northe Europe and grown in the Northern or Middle United States, will produce a bett yield the first year than if grown on their native soil. One reason, and the princip one, for these facts is, that every plant has a native region which is limited in exten and that when an attempt is made to grow it out of that range it soon deteriorat and requires to be renewed from seed grown in its native range. This is particular true of sea island cotton, seed of which has been planted in every cotton-growi soil in the world, but which rapidly degenerates and can only be grown away fro its native region by the constant use of fresh seed.

These peculiarities of varieties of plants is what has brought the business of gro ng seeds to so large proportions. Another reason why the change of seed is oft beneficial to the farmer is, that the diseases which afflict our crops and the insec which prey upon them prefer some varieties to others, and the diseases or insects w become more abundant in the localities where the varieties they most prefer are mo cultivated. If, then, a new variety be introduced, one which is no better in any w than the other, only in so far as it is less subject to the ravages of insects, there is a vantage to be derived from the change.

The Department analyses of the average composition of American corn show that, in the matter of weight of nearly eleven hundred specimens, the heaviest corn comes from Virginia, North Carolina, Kentucky, and Louisiana, all of the Dent variety.

Another analysis shows that American oats are higher in albuminoids than the far-famed Irish grain. Oats in Scotland range in weight from 42 to 50 pounds per bushel. In this country they vary from 20 to 45, and in rare instances 50, pounds. The weight of oats in the United States is usually less than in England or Scotland. The most common legal weight of oats is 32 pounds to the bushel. It varies from 30 pounds in Maine, New Jersey, and Pennsylvania to 34 pounds in Nebraska.

Prof. A. E. Blount, of the Colorado Agricultural College, in a communication dated October 3, 1885, says:

Every sample of wheat, oats, barley, and rye I have received from all sources improves by being raised and selected here. My experience, experimenting with seeds from all parts of the world, is, that our own are by far the most vital; a greater proportion of them germinate.

The cereals can be improved and bred up to as perfect a state of good qualities as stock. They are as susceptible of improvement in every way.

Seeds are at the foundation of farming, and good seed of good farming. Good seed in the hands of the good farmer is capable of turning a disastrous season into a successful one; of changing losses into profits; of bringing hope amidst discouragements. Good seed means vital seed; fixity of type; fecundity of product; adaptiveness to locality. The last the user must secure; the first three requirements it is among the duties of the distributor to furnish and of the farmer to pay for.

SEED NOMENCLATURE.

Whatever may be said in regard to the seed division and its management by interested or disinterested persons, the fact cannot be established that the different varieties of seeds that are distributed by the Department of Agriculture are sent out under any other name than that received from reliable seedsmen from whom the seed was purchased. In the distribution of seeds from this division the tricks of the trade are not indulged in. No new names are affixed to old and well-known varieties. As the distribution is gratuitous on the part of the Government, those in its employ have no valid reason for multiplying names or substituting high-sounding terms for the original ones. The people are rapidly coming to a practical knowledge of the fact that there are far more names in many of the extemporized catalogues of farm and garden seeds, than there ever are of distinct varieties in actual cultivation.

Dr. E. L. Sturtevant, in his recent address before the National Grange, made the following statement in regard to the importance of nomenclature:

Of what service to report a variety of corn as the best variety for certain defined conditions of climate, when seed purchased under the name probably will be different according to the source whence obtained? Of what use to recommend an oat, so illy described that no one knows even the proper variety, and no two seedsmen's seeds, purporting to be of the same variety, gives plants of like habit or appearance?

In his last annual report he says:

It is extremely desirable that each variety of vegetables should be known among both seedsmen and gardeners under one distinctive name. In many of our garden vegetables conformity to type can only be secured by the most careful selection of seed plants.

[illegible]estly urging the necessity of reform in nomenclature he calls [illegible]on to the fact that it is a work which necessitates the study of varieties under different conditions of soil and climate, and that

one of the most valuable works that can be carried on by experimen stations is an attempt to establish a true nomenclature and descriptio of the varieties of vegetables grown in our country and the bringing t gether as synonyms all the names that are applied to each individu variety.

In speaking of the many different names under which single varietie are sold, he mentions the French Horn or very Early Scarlet Forcin one of the earliest varieties, as being sold under eleven or more differe names. In the report of 1883 it was shown that the Philadelphia Extr Early pea had seven different names.

The tendency [says Dr. Sturtevant] that exists among seedsmen to rename partic larly desirable varieties is well illustrated in the cases already referred to. While a mitting that the word "variety" as applied to vegetables is not specifically defined, is nevertheless evident that the difference between two varieties should be greater tha between normal individuals of the same variety; and it is because the samples w call synonyms have not shown these differences that we are led to pronounce the as such. So long as two distinct investigators cannot be sure that they are exper menting upon the same kind of plant their results cannot be strictly comparabl Even professional botanists have not recognized the importance of variety as a fact in their experiments. Just so fast as we obtain diagnostic points in our vegetab may we hope to succeed in our attempts at close identification.

Mr. W. J. Green, of the Ohio experiment station, says he has a "cer tain pea under twelve different names, from as many seedsmen, bu that they are all so near alike as to make distinction impossible excep by the most careful comparison." He further says, "that when a per son pays a high price for a mere name, he feels like expressing hi opinion of the seedsman from whom the purchase was made in the plain est possible Anglo-Saxon." This reprehensible habit of renaming ol things is one which all honest seedsmen are, or should be, prompt i condemning. It tends to the greatest possible confusion in seed nomen clature. This uncalled-for multiplication of high-sounding names fo some old variety is not confined alone to seeds. The same cause for com plaint is common in regard to plants and fruits. In regard to seeds, i would be infinitely better for reliable seedsmen to cut down the list o varieties, carefully excluding from their catalogues all that are know to be worthless.

METHODS OF DISTRIBUTION.

It is becoming more and more evident that there should be, as sug gested in your address to the convention of delegates from the variou agricultural colleges and experiment stations held in the seed divisio building, July 8, 1885, some very important modifications in the metho of distributing the seeds which are annually sent out.

An increased appropriation could be very advantageously used in co operating with the directors of experiment stations in the various State n securing and tabulating, for the use of the Department and for pub ication and general distribution, the reports relative to the adaptatio of the various varieties of seeds for special localities in the various State where tested. Such annual or, still better, quarterly reports from expe iment stations, agricultural colleges, county and subordinate grange farmers' clubs, and other agricultural organizations, would, when care ly compiled, form a most valuable addition to our current agricultura terature, and would be more eagerly sought for and read by thinking working farmers, than almost any other information relating to wha must ever be the most important and leading occupation of mankind.

In conclusion I herewith annex the following tabulated statem

Tabulated statement showing the quantity and kind of seeds issued from the seed d of the Agricultural Department, under the general appropriation act of Congres July 1, 1884, to June 30, 1885.

Description of seeds.	Varieties.	Senators and Members of Congress.	Statistical correspondents.	State correspondents.	Miscellaneous applicants.	Gra
		Packages.	*Packages.*	*Packages.*	*Packages.*	*Pa*
Vegetable	197	2,446,307	147,401	43,034	352,913	2
Flowers	175	464,898	104,760	23,325	171,967	
Herbs	10	.....	.....	.....	334	
Tobacco	13	159,967	707	580	7,041	
Tree	59	654	18,072	20	2,528	
Sunflower	1	510	123	.....	1,707	
Opium poppy	1	.....	.....	.....	56	
Pyrethrum	1	.....	20	.....	143	
FIELD SEEDS.						
Wheat	5	22,483	20,248	.....	1,753	
Oats	2	8,591	2,196	2	1,167	
Corn	2	1,745	33	2	950	
Barley	1	73	16	.....	148	
Buckwheat	1	51	8	.....	108	
Rye	1	11	.....	.....	.....	
Sorghum	2	19,918	136	3,574	3,867	
Turnip	10	422,794	102,008	29,930	.....	
Sugar beet	2	836	16,668	3,574	1,124	
Mangel-wurzel	2	150	22	.....	78	
Grass	8	13,780	44	3	2,694	
Clover	4	15,532	29	1	628	
Cow-pea	2	.....	4	.....	114	
Millet	2	1,223	50	2	284	
Rice	1	.....	.....	.....	4	
TEXTILE.						
Cotton	4	34,898	49	234	775	
Hemp	1	.....	.....	.....	11	
Jute	1	.....	.....	.....	2	
Ramie	1	.....	15	.....	119	
Grand total		3,600,421	412,609	104,281	550,515	4

WM. M. KING,
Chief of Seed Divis

Hon. NORMAN J. COLMAN,
Commissioner.

REPORT OF THE BOTANIST.

I have the honor to submit a report upon subjects which have the attention of the botanical division during the current year. s, first, to foreign medicinal plants, which it is believed might ssfully introduced into cultivation in this country; second, to a of our native medicinal plants, which it is desirable to render to the public on account of present and prospective value; and the characters of fungous plants, and to some special forms of nifestation in the production of destructive plant diseases, pre- the assistant botanist, F. L. Scribner, and others.

number of years past the attention of medical men and phar- has been unusually attracted toward the subject of medicinal oth native and foreign, and the last annual meeting of the Pharmaceutical Association, by resolution, requested the sioner of Agriculture to take measures for the introduction into on in this country of such of the important foreign medicinal s would be adapted to our climate, in order that they might be obtained in a fresh state, and that another industry might be our country's resources. It is represented that many hundred l dollars are annually sent abroad for drugs and medicinal sub- that might be produced at home. There is no doubt at all that the most important medicinal plants, as the opium poppy, the plant, the licorice plant, arnica, belladonna, digitalis, and hers are perfectly adapted to our climate and could be cultivated ction, as we know with respect to some of them from experiments any years ago. Some other semi-tropical products, as ginger, , vanilla, jalap, and sarsaparilla, may in all probability be suc- cultivated in the extreme southern portion of the country, and l seem well that means should be taken to give such plants a rial.

and powerful anæsthetic remedy, prepared from the leaves of called coca, or, botanically, *Erythroxylon coca*, has been re- troduced into medical and surgical practice.

hrub is a native of Central and South America, and on account ifficulty of obtaining the leaves in a fresh and active state, it thought highly desirable that the growth and cultivation of t should be attempted in some locality within our own borders. respect to our native medicinal plants and drugs, their collec- l traffic have been very generally extended during the last de- that thousands of people in different parts of the country, in the mountain regions of North Carolina and Tennessee, and Southern and Western States, are employed at certain seasons r in this enterprise. Fears are expressed that some of these coming exterminated in their native habitats; and in re- of them, as, for instance, the ginseng plant, the time has they may probably be made the objects of profitable culti-

FOREIGN MEDICINAL PLANTS.

OPIUM.

This important drug is the concreted juice which exudes from wounds or incisions made in the capsule (pod) of the poppy (*Papaver somniferum*). The principal supply in commerce comes from Hindostan, Persia, Turkey, and Egypt. It is stated that the best ground for the culture of the poppy is a light soil with a rocky subsoil. The ground should be rich and dry. In Smyrna the sowing usually commences in October. In that climate the growth progresses slowly throughout the winter months. When the plants attain a height of 2 inches they are thinned out to the required distance and hoed. This operation is repeated occasionally, as may be necessary. The plant ordinarily reaches the height of 2 or 3 feet, but in rich soil sometimes becoming 5 or 6 feet high. It begins to produce flowers usually about the 1st of May. Soon after the fall of the flowering leaves the pods begin to enlarge and are matured in two or three weeks. The flowering continues on the branches or on other plants through two or three months. The business of collecting the opium begins in the latter part of May and continues until the middle of August. When the capsule is mature incisions are made through the outer skin with a peculiar knife, when the juice exudes in small drops which soon harden, so that in a few hours the opium may be collected. One company of men are employed in making incisions upon such plants as they judge to be in a fit condition and they are followed in a few hours by others who collect the soft juice by scraping it off and placing it on a tin plate held in the hand. When a sufficient quantity has been collected it is transferred to a leaf, in which it is enveloped. Only the best quality is treated in this way. The inferior is removed into a shallow wooden tub, in which it is left a few days to dry, and then rolled in balls of various sizes and enveloped in leaves in the same manner as that of the first quality. The work of collecting is performed both by men and women. The poppy is an exceedingly tender plant, the growth of which is attended with many dangers before reaching maturity. A slight frost, continued rains, or great heat may ruin the crop of a whole district in a very short time.

The opium poppy is cultivated in several parts of Europe, especially in the northern departments of France and in the south of Germany mainly for the seeds from which is obtained an oil, called poppy-seed oil, which is employed for culinary purposes, and in the manufacture of soap, &c., as a substitute for olive oil, but in both countries good opium is also produced.

The poppy plant has been tried in this country in Connecticut, Vermont, New York, Pennsylvania, Wisconsin, Kansas, and other States including California. There is no doubt that a good quality of opium can be produced here. The mode of cultivation would necessarily vary some to correspond with the variations of climate. In the Northern States the time of sowing is from the 5th to the 20th of May. In the Southern States it could be sowed earlier, and in that warmer climate it might be expected that there would be less risk of frost, and the production of a better quality of opium. The plant is sufficiently matured to commence gathering the opium in about ninety days. Full directions of the culture and gathering are given in the Agricultural Report for 87[illegible] The experiments that have been made in this direction do not seem [illegible] satisfactory, on account of the much greater cost

of labor in this country than in Europe and Asia. Probably it might be made profitable by farmers as one of a number of crops, and by small cultivators who could command labor at moderate prices.

PERUVIAN BARK.

Next to opium in importance as a medicinal vegetable is the cinchona tree, which produces Peruvian bark, from which is prepared quinine. This tree is a native of the tropical portions of South America, growing in the mountainous regions of Brazil, Peru, Venezuela, &c. It has been successfully introduced into the East Indies, Java, and also in Jamaica. We have not in this country the climatic conditions for growing this tree, unless possibly some portions of Florida or Southern California should prove suitable.

LICORICE—*Glycyrrhiza glabra.*

This is an herbaceous perennial plant of the order *Leguminosæ*, which grows to the height of 3 to 5 feet, furnished with many large, alternate, pinnate leaves, and with violet or purple flowers like those of a pea. It is a native of the south of Europe, Syria, Southern Russia, Persia, and Barbary, and is cultivated not only in those countries, but in France, Spain, Germany, Sicily, and England. Some attempts have been made at its cultivation in this country, but without much satisfaction. The part of commercial importance is the root and an extract made from it. The plant requires a deep soil, alluvial or sandy loams being the best, in which the roots spread and extend to the depth of 2 or 3 feet. The process of digging them from the ground is a laborious operation. They require three years' growth before they acquire the proper size for commercial use. They are very largely used in medicinal preparations, in confectionery, and in breweries. Immense quantities are annually introduced into this country. Nearly 40,000,000 pounds of the root and over 1,000,000 pounds of the extract were imported in 1884. The long time required for the maturity of the plant will be a hindrance to its cultivation in this country. Still there are probably locations where it might be advantageously introduced.

RHUBARB—*Rheum officinale.*

Several species of *Rheum* seem to be employed in the production of the various kinds of the rhubarb of commerce, as *Rheum compactum*, *R. palmatum*, *R. undulatum*, &c. They are indigenous to several countries of Asia, principally Russia and Turkey, and are very similar in appearance to the common garden rhubarb, but of larger size. The root is the part which is medicinally employed. Of the crude roots there were imported into our country in 1884 about 124,000 pounds. The plant has been successfully cultivated in England, and some attempts have been made in the same direction in this country. Undoubtedly many parts of our territory are well suited to the cultivation of the plant, which requires as much as four years to reach maturity. They require a rich, deep soil and thorough cultivation. The plants may be started for the first year from seed in nursery rows, and then transplanted to permanent beds.

VANILLA BEANS—*Vanilla planifolia.*

this substance is little employed in medicine, it is largely
chocolate, confectionery, ice cream, &c. The plant
ve or n Mexico, perhaps also of the West Indies, from
AG—

whence it has been introduced into other tropical countries. It belong to the orchid family. "Though most of the vanilla of commerce i derived from plants growing wild in the forests, yet much is the proc uct of a species of cultivation which is very simple. All that is nec sary is to cut a slip of the stem from the lower part and plant it nea the trunk of a tree, attaching it by cords. The plant immediately tak root in the bark of the tree, and sends out air-roots, which, re ain the ground, fix themselves in the soil." It also climbs the ees b means of the aerial roots. It begins to bear fruit in three yea continues productive for thirty or forty years. The leaves e dark-green, oval, and sessile. The pods are usually 6 to 8 inc a quarter of an inch thick, nearly straight, and within the tough ou coating contain a soft black, pulpy matter, filled with minute, bl shining seeds. This interior pulpy portion has a peculiar agreeab odor, and a warm, aromatic taste.

There is reason to think that this plant may be successfully cult vated in Southern Florida.

There was imported into the United States in 1884 over 75,621 pound of vanilla, having a value of over $357,821.

MARSH-MALLOW ROOT—*Althea officinalis.*

This is a plant of the mallows family (*Malvacæ*), native in many of Europe and Asia. It has a perennial root, from which are sent u annually a number of erect leafy stems from 2 to 4 feet high, branchin toward the top, producing leaves and flowers much like those of th common hollyhock, but smaller. It prefers saline locations, as n river banks, and low coast land. It has become naturalized to s extent on the salt marshes of the coast of New England and N York.

The roots are the part principally employed, although the leaves a flowers possess the same properties. They are called demul nts. hav ing a mild, soothing action on the mucous membranes, useful in coughs and for external application on inflamed surfaces. It is a employed in confectionery. The roots are collected in autumn fr plants which are at least two years old. Our commercial supply is ob tained from Europe, but we have much marshy land which might b advantageously utilized by introducing these plants.

OTHER PLANTS.

Many other minor medicinal herbs could undoubtedly be cultiva with us. Among them may be named camomile, arnica, belladon digitalis, and colchicum. Peppermint and spearmint have been cessfully and to a considerable extent cultivated in Michigan and Ne York.

Pyrethrum has recently been cultivated with great success and prof in California, chiefly for its use as an insect-destroying powder.

NATIVE MEDICINAL PLANTS.

[illegible]SANGUINARIA DIPHYLLA—*Twin Leaf; Rheumatism Root.*

A [illegible] herbaceous perennial, of the order *Berberidaceæ*. The rh [illegible]ma or root-stalk is thick and short, emitting a mass of matted fibrou roots. From the root-stalk is sent up a number of long-stalked, ere leaves, the leaf and stalk when mature being a foot or more in lengt

The leaf is curiously parted into two halves, giving rise to the name "twin leaf." As a whole the leaf is round-ovate in form, with the base deeply heart-shaped. When mature it may be 6 to 9 inches in diameter. It is smooth and with the margins entire or wavy-toothed. There are three to five principal veins to each half, which proceed from the point of junction and ramify to the surface. The flowers come from the root on one-flowered naked stalks (scapes), which rise nearly to the height of the leaves. The flower has about four linear-oblong sepals, which drop off upon its opening; within these are eight oblong white petals, three-fourths to 1 inch long, and spreading and soon falling off. There are eight stamens, one before each petal. The ovary is roundish-oval, one-celled, becoming obovate, and when ripe opening at the top by a transverse lid. This plant grows in rich, shady woods, from Western New York to Wisconsin, and sparingly southward along the Alleghany Mountains. It is most abundant in the Western States, from Ohio to Illinois and Kentucky. It is named in honor of Thomas Jefferson. It has a popular reputation as a stimulant-tonic, especially for the cure of rheumatism. PLATE I.

ILEX CASSINE—*Yaupon, Cassena.*

A small tree, 15 to 25 feet in height, or only a shrub, growing in the Southern Atlantic and Gulf States, near the coast and in the southern part of Arkansas. It is said to reach its greatest development in the river bottoms of Eastern Texas. It is a handsome evergreen. The leaves are three-quarters of an inch to an inch and a half in length, thick, smooth, shining green above, pale beneath, mostly of an oblong or ovate form, sometimes entire on the margins, sometimes with small obtuse teeth. They are alternate and very short stalked. The flowers are in small clusters in the axils or points between the leaf and the twig. They are white and minute, the parts requiring a glass for their plain discrimination. The calyx has from four to six obtuse teeth. There are from four to six sepals and as many stamens. The ovary develops into a small red berry, becoming black, of the size of a small pea. These berries consist mostly of the two to four bony seeds which they contain. The leaves have a peculiar intoxicating property, and were used by the Indians under the name of black drink, both as a medicine and as a drink of etiquette at their councils. Professor Venable, of the University of North Carolina, has recently made an analysis of the leaves, and states that they contain a small percentage of caffeine, or the peculiar principle found in coffee and in the mate, or Paraguay tea (*Ilex paraguayensis*), of South America. The leaves of the Dahoon holly (*Ilex dahoon*) are to have similar properties. PLATE II.

RHAMNUS PURSHIANUS—*Cascara Sagrada.*

This shrub or tree grows on the Pacific slope from Northern California northward to Oregon and Washington Territory. It is also sparingly found in Idaho and Montana. It varies much in size according to location, in some places occurring only as a large shrub 10 to 12 feet high, in others becoming a small tree of 20 to 40 feet in height and a foot or more in diameter of trunk. The leaves are elliptical in form, until, from 2 to 6 inches in length, 1 to 3 inches in breadth, with very [illegible] the margin, or sometimes nearly entire. The petiole or stem [illegible] is half an inch to an inch long, and, with the young twigs [illegible] under side of the leaves, is covered with a fine brownish pubes-

cence. There are ten or twelve pairs of strong ribs or veins on eacl side of the central midrib. The flowers are small and occur in cluster of ten to twelve, which proceed from the axils of the leaves, there bein one common stalk or peduncle, and a more delicate pedicel for eac flower. The flowers are greenish in color, with five acute sepals and a many smaller hooded petals, which are divided at the point. They als have each four or five stamens, and a short three to four cleft style. Th flowers are succeeded by small black berries of the size of a pea, whic have a thin pulpy exterior, the main portion consisting of three bon nutlets or seeds.

The bark possesses very active cathartic properties, and has been re cently introduced into medical practice, and large quantities are annu ally gathered in Oregon for the drug trade. The bark of *Rhamnus ca tharticus* of Europe possesses cathartic properties and has been medici nally employed for a long period. Probably this property is commo to many species. In California there is a species called *Rhamnus cali fornicus*, the bony seeds of which have been sometimes employed as substitute for coffee, although they contain nothing of the peculiar prin ciples of the true coffee. PLATE III, Fig. *b*, flower enlarged; *c*, trans verse section of fruit.

CASSIA MARILANDICA—*Wild Senna; American Senna.*

The genus *Cassia* belongs to the order *Leguminosæ*, and is very ex tensively diffused over the globe, and includes some four hundred spe cies, mostly herbaceous, but some shrubs and some trees. The commo medicinal senna consists of the leaves of two or three species of C which grow in Egypt, India, and Arabia.

In the United States we have about twenty herbaceous species, onl one of which, *Cassia marilandica*, has obtained reputation for medica use. This is a vigorous plant, having a perennial root, the stalks, man from the same root, growing 4 or 5 feet high, with numerous alternat large pinnate leaves, 6 or 8 inches long, and composed of about eigh pairs of oblong-lanceolate leaflets of a light-green color, which are about inch to 1¼ inches in length, smooth, tipped with a very short bristle like point. Near the base of the leaf-stalk is a small dark-colored stalke gland of unknown use. The flowers grow at and near the top of th stem in short racemes from the axils of the upper leaves and are eac about one-half inch long. The sepals are five, oblong, thin, shorter tha the petals; the petals are five, bright yellow, half an inch long, rathe curved, obtuse, and broadest near the top. There are ten stamen which are unequal in length, and some of them imperfect, the anther opening by two pores at the apex. The young germ or pod is quit hairy, but becomes in age a smooth, linear, curved pod, 4 to 6 inche long, and containing twenty or more seeds, a depression of the pod oc curring between each of the seeds.

Our plant is related to the Eastern senna in its botanical habit an resembles it in its medicinal virtues, but requires about one-thir greater quantity to produce the same effect. The Eastern senna is s cheap that there is little inducement for the gathering or use of ou native one. PLATE IV, Fig. 1, an enlarged flower; 2, mature pods.

GILLENIA TRIFOLIATA—*Indian Physic.*

A perennial herbaceous plant of the natural order *Rosaceæ*, grow throughout most of the States east of the Mississippi River u

shady, moist locations. It is most abundant east of the Alleghany Mountains. The root consists of "many long, slender, brown branches, proceeding from a thick, tuber-like head." Usually several stems rise from the same root; they are erect, slender, smooth, from 2 to 3 feet high, branched above, and very leafy. The leaves are in threes (trifoliate), each part or leaflet, having a short stem or petiole, is mostly oblong or lance-oblong in outline, or sometimes obovate, from 2 to 3 inches long, sharp pointed, and the margins have many sharp, close teeth. Most of the leaves are set close to the stem (sessile), and have at the base of each a pair of small linear-lanceolate stipules, like diminutive leaves, decreasing in size from below upwards. The flowers grow from the upper branches on slender peduncles, 1 to 2 inches long, and form a loose, open, corymbose panicle. The calyx is tubular bell-shaped, a quarter to a third of an inch long, with five small, erect teeth. The five petals are inserted on the inside of the calyx near the top. They are linear-lanceolate, three-fourths to two-thirds of an inch long, spreading, and of a white or pale rose color. The stamens vary from ten to twenty in number, are small and inclosed in the calyx. There are five styles and ovaries, which are finally succeeded by five small pods, cohering at their base, separate above, each valve containing about two seeds.

The dried root is the part used medicinally, and is of an emetic and purgative nature. It has been used as a substitute for ipecac. It was employed by the Indians, and from them the people of the colonies learned its properties. There is another species, the *Gillenia stipulacea*, which has essentially the same properties. It is gathered for commercial purposes, to some extent, in North Carolina.

HAMAMELIS VIRGINICA—*Witch Hazel.*

A small tree, 15 to 25 feet high under favorable circumstances, but more commonly a straggling bush, 10 to 15 feet high, growing in most of the States east of the Mississippi usually in damp woods or on the banks of streams. It forms the type of a natural order (*Hamamelaceæ*) which includes about fifteen genera in different parts of the world. The genus *Hamamelis* is represented in the United States by one species, *Hamamelis virginica*, another very similar one being found in Japan. The leaves are short-stalked, 3 to 6 inches long, oval or obovate, slightly heart-shaped at the base, with the sides unequal, with straight conspicuous veins, the margins wavy or with coarse obtuse teeth, and somewhat downy when young. The tree or shrub is remarkable for its late period of flowering, which is in September and October while the leaves are falling, and continuing on until winter. The development of the ovary or young fruit begins in the following spring and is not matured until the fall. The flowers grow in small clusters or heads, each with a three-leaved scale-like involucre at the base. The calyx is thick, four-parted, and woolly on the outside. The petals are four, strap-shaped, nearly half to three-quarters of an inch long, and of a bright yellow color. There are eight short stamens, only four of which are perfect. The small hairy ovary occupies the center of the flower; this finally develops into a two-beaked, two-celled, thick and hard pod, with a single, black, bony seed in each cell.

Both the bark and the leaves are used medicinally in domestic prac-
in the preparation of certain proprietary remedies, and in the
e of physicians. It is stated that they were used as a remedy
ndians. PLATE VI, Fig. 1, flowers natural size; 2, an enlarged

LIQUIDAMBAR STYRACIFLUA—*Sweet-gum; Red-gum; Bilsted.*

The sweet-gum is a large tree, native in the United States from C
necticut westward to Illinois, southward to Florida and Texas, thence i
Central and Southern Mexico. It belongs to the witch-hazel fan
(*Hamamelaceæ*). It grows from 80 to 150 feet high, reaching its grea
development in bottom lands of the Lower Mississippi. Its symn
rical, compact form and bright, glossy, star-shaped leaves make it on
the most beautiful trees of the forest. The flowers are of two kir
the male and female being in distinct clusters; the male flowers are
a raceme of small, globular clusters at the end of the twigs, having v
many stamens intermixed with small scales. The female flowers
situated below the male ones; they are inconspicuous at first, but gr
ually enlarge into a round head or cluster of two-celled ovaries,
with two beak-like points, the whole when mature forming a globu
spiny ball of about an inch diameter. The leaves are from 3 to 6 inc
in diameter, rounded in outline, and divided into from 3 to 7, usi
about 5, pointed lobes. They are smooth and shining, finely ser
on the margins, and fragrant when bruised. In the warm portion
the country and in Mexico a balsamic juice flows from the tree, wh
has medical properties. The United States Dispensatory states t
this juice "is a liquid of the consistence of thin honey, more or
transparent, of a yellowish color, of a peculiar, agreeable balsamic o
and a bitter, warm, and acrid taste. It concretes by time, assumir
darker color. It is sometimes collected in the form of tears, produ
by the spontaneous concretion of the exuded juice." This resin
gum has properties very similar to that of the true storax whicl
yielded by an allied species of *Liquidambar* growing in Asia Mi
The gum of our native tree has been collected to a considerable ex
for the preparation of chewing gum; it has also been medicinally
ployed for the same purpose as storax, in the treatment of catar
affections and of pulmonary complaints. PLATE VII.

GRINDELIA ROBUSTA—*Gum-plant.*

An herbaceous perennial plant of the order *Compositæ*, growin
California. It has an erect, leafy stem, 1 to 2 feet high, branching
the top, the branches terminated by a single composite head of flow
somewhat resembling the flower-head of saffron, the body of whic
about 1 inch across, with the narrow, strap-shaped, yellow flowers spr
ing out in every direction from the margin. The leaves are altern
rigid, mostly oblong, the upper ones lanceolate, the base sessil
partly clasping the stem, and the margins often with coarse sharp te
the upper ones becoming entire. The flower-head, which is usually
garded as a single flower, is really a compact mass of small flowe
two kinds, the inner ones having a tubular corolla, and the oute
marginal ones having a long, strap-shaped corolla. This cluste
flowers is surrounded by an involucre of many lanceolate-pointed, g
scales, whose tips are recurved, presenting a rough appearance.
involucre is usually gummy with a balsamic exudation.

The central flowers of the head are generally infertile and are c
-sly supplied with fine, bristle-like pappus. The outer flowers or a
of them are fertile, producing a small, oblong, smooth seed. This p
s common throughout the western part of the State of California
is commonly known as gum-plant, or sometimes, but improperly,
-ear. There are three or four other species of *Grindelia* in Califor

and several more in Oregon and the interior, extending to New Mexico and Arizona. They are all closely alike in general appearance and probably also in properties. The species we have described has some reputation in California as a medicinal plant, particularly as an antidote to the poisoning of the poison oak, *Rhus lobata;* it has also within a few years past been introduced into medical practice for use in chills and other diseases. PLATE VIII, Fig. 1, an enlarged disk-flower, showing the achenium surmounted by the rigid, awl-like pappus.

ERIODICTYON GLUTINOSUM—*Yerba Santa.*

This is a low shrubby plant of California, growing from 3 to 5 feet high. The stems and twigs are smoothish and generally showing more or less of a resinous exudation, particularly on the vigorously-growing twigs. The leaves are thick and rigid, alternate, lanceolate in form, usually 3 or 6 inches long, acutish at the point, and tapering at the base into a short petiole, the margins irregularly toothed, smoothish on the upper surface, the lower surface with a prominent fine reticulation, whitened between the veins by a fine and close, woolly pubescence. The flowers terminate the branches in a panicle, and are collected in numerous small, rather crowded, cymes or clusters. The individual flowers are about half an inch long, the calyx small and deeply divided into five sepals, the corolla of one piece (monopetalous) rather trumpet-shaped, with the border five-lobed, its color varying from purple to white. Attached to the inner side of the corolla near the base are the five stamens. There are three threadlike styles nearly as long as the corolla, and at the base a roundish, two-celled pod containing the seeds. The plant belongs to the order *Hydrophyllaceæ.* The upper surface of the young leaves and twigs are covered with a resinous, balsamic exudation. The under surface presents a beautiful network of veins with a fine, whitish pubescence between them. The leaves have a balsamic taste, and have long had a local reputation among the old Spanish settlers in diseases affecting the mucous membranes, as in chronic coughs, catarrhs, consumption, &c. PLATE IX, Fig. 1, mature pods.

EUPHORBIA COROLLATA—*Wild Ipecac; Euphorbia.*

An herbaceous perennial, belonging to the order *Euphorbiaceæ*, growing very commonly in sandy or gravelly soil in most of the States east of the Rocky Mountains. It has a prostrate, knotty rhizoma or root-stock, from which are sent up one or more stems which rise to the height of 2 or 3 feet. These stems are generally slender and unbranched, except near the top. They have numerous scattering leaves from near the base to the top. The leaves are nearly sessile, and varying in form in different varieties of the plant, but usually quite narrow and linear or oblong, about 2 inches long, and yielding a milky-juice when broken from the stem. At the upper part the stem divides into about five principal branches, surrounded by a whorl of five small leaves. These branches again subdivide in threes and twos, the slender extremities bearing each a small white flower. The flowers have the peculiar character of this order, l ng formed of a small, cup-shaped envelope, called *involucre*, with co icuous white lobes or appendages on the border. On the in- of the cup or involucre are several small stamens, and rising from of a stalk which rises out of the cup is the fertile flower with es and a roundish, three-celled ovary. The root of the plant is medicinally to some extent, having some of the properties of

ipecac, for which it has been substituted. PLATE X, Fig. 1, an enlarged flower showing the involucre in part, with the stamens, and the ovary raised on a stalk or stipe above the flower.

EUPHORBIA IPECACUANHA—*Wild Ipecac; American Ipecac.*

This, like the preceding species (*E. corollata*), is an herbaceous perennial, low and tufted; numerous slender stems arise from a thick, irregular root, which sometimes penetrates several feet in the sand in which it grows. The stems are erect or procumbent, smooth, from 6 inches to 1 foot long, and fork or divide in twos several times. The leaves are very variable in size and form, being sometimes narrowly linear, sometimes oblong or obovate, and from half an inch to an inch and a half long; they are opposite, sessile, smooth, and entire. The flowers are single, on peduncles an inch or more in length, proceeding from the forks or axils. In structure the flowers and pods are essentially the same those of *Euphorbia corollata*, already described.

The plant grows in sandy woods and shores, near the sea coast, fr New Jersey southward to Florida.

Like all the species of the genus *Euphorbia* the stems abound in a acrid, milky juice. The root is the part which is medicinally employed Its action is similar to that of the officinal ipecac. PLATE XI, Fig. 2 transverse section of pod; 3, seed.

ARISTOLOCHIA SERPENTARIA—*Virginia Snake-root.*

A small herbaceous perennial plant; the slender stems are unbranche and usually about 1 foot high, the upper part having about 4 to 6 com paratively large leaves, the lower part of the stems naked, except the base, where they give rise to a few long-stalked flowers. The leave are ovate or oblong, with a heart-shaped base, 2 to 4 inches long smooth or smoothish, rather acute pointed, and on short petioles. Th flowers, of which there are but 2 to 4, are all near the base of the stem on small branches or peduncles. They are small, half to three-fourth of an inch long, of a purplish color, and a peculiar form. They are d titute of a calyx, and have a tubular corolla, bent like the letter S, nar row below and expanded at the top. There are six sessile anthers a tached to the sides of the fleshy pistil. The fruit is, when mature, small obovate, 6-sided, 6-valved, capsule or pod. The flowers appea in May and June and the pod matures in September or October. I grows in rich, shady woods, from Connecticut to Indiana, and southwar along the Alleghany Mountains. From the main root proceeds a mas of slender fibers 3 to 6 inches long. This is the portion of the plan which is used as a medicine. There are several other species of *Se pentaria* in the Southwest, which probably have the same properties t a greater or less extent. There are also two species in Europe whic are there employed for the same purposes as our plant. Although *Se pentaria* is an old remedy, it does not appear to be extensively employe at the present time. PLATE XII, Fig. 2, a flower enlarged; 3, stamer on the interior of the corolla; 4, capsule or pod.

ASARUM CANADENSE—*Wild Ginger.*

A small perennial herbaceous plant, growing in rich, shady woods o hill-sides, from Canada to the mountains of North Carolina and w to Iowa.

That part which is commonly called the root is botanically called th rhizoma, or a creeping underground stem, usually 2 or 3 inches long, an

half an inch thick, giving off fibrous roots from the lower side. The extremity of the root stock sends up a pair of kidney-shaped leaves on stalks 6 to 10 inches long. The leaves, when fully developed, are 5 to 6 inches broad, and about 3 inches from the base to the obtuse point. The margins are entire. The leaves and stalks, when young, are somewhat hairy, becoming nearly smooth in age. From between the leaves, close to the ground and terminating the root-stock, there issues a single flower on a drooping peduncle 1 or 2 inches long. This flower, when fully developed, is about an inch in length. It has no proper corolla, but a bell-shaped calyx divided above into three oblong, short-pointed, spreading lobes, which are of a brownish-purple color inside. The lower part of the calyx is pubescent externally and coherent with the ovary, which above spreads out into six radiating stigmas. There are twelve stamens united to the base of the style, the anthers short. The flower is usually buried among the old leaves which cover the ground where it grows. The fruit is formed of the thickened, fleshy calyx and ovary, divided into six cells, each containing a number of small seeds. The wild ginger belongs to the same botanical family as the *Serpentaria*. The rhizoma or root-stock has an agreeable aromatic taste approaching that of the true ginger, and also somewhat like that of *Serpentaria*. Medicinally it is a warm, aromatic stimulant. It has been employed as a substitute for ginger in common domestic use. The leaves and flowers possess the same taste and quality as the root-stock.

It is purchased, by a Carolina firm, in three forms: (1) The fibrous roots from large root-stocks; (2) the root-stock without the fibrous roots; and, (3) the root-stock with the fibrous roots. In the first form their annual average purchase is 1,000 pounds; in the second and third forms, about 5,000 pounds of each. PLATE XIII, Fig. 2, flower enlarged with the sepals removed; 3, transverse section of the fruit.

ANEMOPSIS CALIFORNICA—*Yerba Mansa.*

A perennial herbaceous plant, growing in California, Arizona, and Northern Mexico. It belongs to the natural order *Piperaceæ*. It has a thickish, creeping root-stalk, which has a pungent, aromatic, and astringent taste. From this proceeds a number of oblong or elliptical leaves, from 2 to 6 inches long and half as wide, on stalks as long as the blade. These leaves are entire, obtuse or obtusish, with a thick midrib and and a two-lobed or heart-shaped base. From the same point also proceed one, two, or three flowering stalks, 6 to 8 inches high, which are naked below, near the top producing a broadly ovate, clasp- , and one or two leaves like the radical ones, but smaller, ter- g with a conical compact flowering spike, one-half to one and f inches long. This flower-spike has at its base an involucre of ave eight whitish oblong leaves, which look like petals, and are an inch long. The true flowers are on the conical receptacle e the involucre. They are very small and numerous, each with a whitish bract at its base. Each flower has six to eight stamens, three or four spreading stigmas joined below in a many-seeded ov .

a ba ice of this head or cone of flowers, with its white invo- e. n like that of an anemone, and from this circumstance the deriv its botanical name *Anemopsis*—meaning like an anemone. stock is much employed by the Indians and natives in a num- nts, being undoubtedly useful for dysentery and diar- ge amount of tannin contained in it. PLATE XIV.

ARISÆMA TRIPHYLLA—*Wild Turnip; Indian Turnip.*

An herbaceous plant, of the natural order *Araceæ*, of the class of Endogens, growing in moist, rich woods in most parts of the United States east of the Rocky Mountains. It arises from a turnip-shaped *corm* of the size of a small onion, usually sending up two succulent leaf-stalks, 1 to 3 feet long, each of which is terminated by three oblong, pointed leaflets, 2 to 3 inches long. The leaf-stalks are at the base, inclosed in a loose sheath, together with a single flowering stem, which is shorter than the leaves, and at its summit produces the flowering parts, which consist of a cylindrical, club-shaped *spadix*, usually about 2 inches long, and inclosed in a loose, leafy envelope, called a *spathe*, 3 or 4 inches long, with upper part arched over the *spadix*. The *spathe* or sheath is green or veined with whitish and purple stripes. The *spadix* is covered with small, closely-sessile flowers, those of the upper portion being male and those of the lower portion female; these, when fertilized, develop into a roundish mass of pulpy red fruits. The *corm* or bulb is farinaceous, and in the green state imbued with an intensely pungent juice, which is dissipated in drying. The dry *corm* has some medicinal reputation in various diseases, particularly of the lungs. PLATE XV, Fig. 1, the corm; 2, the spadix enlarged, showing the male portion above and the female portion below; 3, matured fruit.

SYMPLOCARPUS FŒTIDUS—*Skunk Cabbage.*

A perennial herbaceous plant, with a cabbage-like aspect, with a strong disagreeable odor. It has a thick, descending rhizoma, from which proceeds a multitude of coarse, fibrous roots, and a cluster of large and broad, heart-shaped leaves, which when full grown are 1 to 2 feet long, on short *petioles* or stalks. The leaves are preceded in very early spring by a few flowering shoots, consisting of a *spadix* and *spathe* which rise but little above the surface of the ground.

The *spadix* or receptacle is globular, very short-stalked, and covered with small, crowded, perfect flowers. These have each four stamens, a four-angled style, and small stigma. In fruit the receptacle becomes a globular mass, inclosing the spherical seeds just beneath the surface. This receptacle of flowers and fruit is inclosed by a thick and fleshy hood or *spathe*, 3 to 6 inches in length, and with the apex bent forward like a beak. This *spathe* decays and falls away in age, leaving the mass of fruit exposed. The roots have long had a domestic reputation for some medicinal purposes, and are also used by some of the medical profession. PLATE XVI, Fig. 1, spathe and spadix just above the surface of the ground; 2, mature spadix, with a section removed showing the seed cavities.

NOTES ON GRASSES.

JOHNSON GRASS IN MONTANA.

The division received, in September, samples of a remarkably vigorous growth of Johnson grass (*Sorghum halapense*) from Mr. William Story, of Miles City, Mont., accompanied with the statement that it had apparently caused the death of several head of cattle on his land and on that of a neighbor. He states that but a very small quantity was eaten, as the cattle were not allowed to stay long in the field. They died so suddenly that the opinion was formed that there was some

y poisonous about the grass. We are at a loss to account for
mstance except on the supposition that the cattle were turned
from a poor pasture on to the luxuriant, succulent growth of
g and that the amount eaten was greater than supposed
ven, or that distending of the stomach from gas formed by
ng food, such as happens frequently when cattle eat too freely
clover. This opinion is confirmed by the fact that although
s been cultivated in the South for forty or fifty years, no
ges have been made against it. One thing seems settled by
n, namely, that Johnson grass will endure a cold, north-
as in the cases mentioned the seed was sown the preceding
l the grass seems to have been uninjured by the frost.
er point would seem to be that the chief value of this grass is
making grass, for which purpose it should be cut several times
he season, and that grazing on it should be managed with cau-

SAINT AUGUSTINE GRASS.

Mrs. J. A. Blanchard, Umatilla, Fla., we learn that *Stenotaphricanum* is called in that section Saint Augustine grass, prob-
its common occurrence about that city, as it is elsewhere on
in Florida and in South Carolina. It seems to be planted for
grass. By dividing the stems and putting two or three in a
soon makes a close, firm sod of coarse grass, which is green
the year. Horses do not seem to like it.

INDIAN MILLET.

this name we have received from two or three sources in the
e of the so-called bunch grasses, which is botanically called
cuspidata, and figured in the Annual Report for 1881–'82. Mr.
Lewman, of Cannonville, Utah, says it is one of the most nutri-
sses he has ever seen and is very early and hardy. It grows
eet high and is very prolific in seeds, which the Indians gather
for making bread. He says that this grass alone is equal to the
of other kinds with grain added, and that horses can do good
it without grain. It grows in all the country from Kansas
he Pacific, especially in the arid regions, and is an important
the native ranches. Although it grows in very arid soil, yet it
in size and thrift whenever it is near water or can be irrigated.
rving of extended trial in the West.

CROWFOOT.

ecies of grass in the Southern States have received the name of
viz, *Eleusine indica* and *Eleusine ægyptiaca*, or, as it is some-
lled. *Dactyloctenium ægypticum*. Dr. H. W. Ravenel, of Aiken,
tes that in the lower and middle portions of that State the
goose-grass is generally applied to the former grass, while the
universally called crowfoot. The former (*E. indica*), he says,
d to rich waste places and old yards and gardens, and is rarely
seen in ordinary cultivated fields, and is never used for hay be-
found only in tufts and sparsely, whilst the latter (*E. ægyp-*
undant as crab-grass (*Panicum sanguinale*) in all cultivated
is commonly used for hay.
portant distinction, which ought to be generally known
popular account of these grasses.

FUNGOUS DISEASES OF PLANTS.

[This chapter, giving outlines of certain fungous diseases of plants, w upon the application of remedi s, was prepared by the Assistant Botanis Scribner.]

It is the purpose of this chapter to present in general term ing characters of some of the chief groups or more destruct of fungi,* a knowledge of which is of the first importance means for their destruction. It will be understood, of course, are many plant diseases which must receive special investiga in the field and in the laboratory, before any definite conclusi reached respecting their nature or the remedies that should be against them.

In spite of the fact that our cereal and other crops of the orchard are damaged to the extent of many millions of do ally by the attacks of fungi, there has been very little done t stituting experiments to find means to guard against them. scarcely less destructive than are our insect foes, for there i plant that does not support at least one of these minute paras the greater number are obliged to nourish a score or more.

The injury they occasion has generally been accepted a ble. People have seen their crops destroyed by the sever the various mildews, the numerous rusts, smuts, and earl diseases caused by fungi, and have stood by inactive, deem selves powerless to prevent these things. This feeling has tered by the assertion that these diseases were wholly due pheric causes—an expression so frequently made and insisted it has become the settled belief of many. Recent progress in science, however, has demonstrated the fallacy of this view ering the real sources of the evil, and what was formerly in mystery is now known to be due to a class of objects whic growth and development, are amenable to the same laws th all organic bodies. These objects may be compared to we instead of robbing useful plants of their food supply in the directly from the plants themselves the food they have pr their own nourishment.

We must not commit the error of assuming all plant mal due to fungi. Other causes may produce disease, and the d determining this cause is by no means so easy as some suppos eral terms, however, plant diseases may be classed as, 1st, th from physical or chemical causes; 2d, those due to the atta seets; and 3d, those occasioned by fungous parasites. The causes may unite in bringing about a diseased condition of hat it becomes impossible to assign the origin of the troubl

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* A fungus (plural fungi) is a plant of low organization, having a ve reproductive system, but wholly destitute of green coloring matter (cl The species are either parasitic, feeding on living plants or animals, or deriving their nourishment from dead or decaying substances.

The vegetative system generally consists of elongated, slender, thre hyphæ, collectively termed *mycelium*. The mycelium of the para grows either upon or within the tissues of the plant—called the host pla ng it. There is much similarity in the mycelium of the different fungi reproductive system there is great diversity, and the peculiarities of st development in the fruit afford the essential characters of classification The diversity may be, however, in the reproductive system, the universal formation of the spore, or organ analogous to the seed of higher plants.

It not unfrequently happens, also, that the symptoms of ised by insects are very similar to those induced by fungi, it a difficult matter to trace the malady to its real source. The or copical examination is sometimes necessary to determine t aggressors. When insects and fungi are both present in a ise, as they not infrequently are, who is to say which tive agents in the case? The closest study of the ento- and the mycologist may result only a conflict of opinions.

nably insects, by wounding the bark or leaves, or by other- ing the vitality of the tree or plant, pave the way for the at- of fungi, whose growth and activity continue the injury already . A debilitated condition of the plant, arising from the lack of or insufficient nourishment, an excessive vegetative growth, sud- ges of temperature, or an undue amount of moisture in the soil and even certain electrical conditions of the atmosphere, may, or together, invite the growth of these minute parasites, which no ots are the ultimate cause of the injury occasioned. It is now nown that many plant diseases are directly due to the attacks of parasites, for certain plants are affected with peculiar fungous whatever may be their physical condition or surroundiugs. If ses be wholly due to atmospheric causes, why were not the of Europe "struck" with mildew before the introduction of *nospora* of the vine into that country? Or why has the black the grapes, so destructive here, never been observed across the c?

true that many diseases can be avoided by keeping the plants in r of growth; as a man may escape a contagious disease by care- tending to his physical condition, acquiring a degree of vitality it to resist infection. The plant diseases in question are chiefly , and the laws that apply to animals in such cases, are, in the plicable to plants.

we have learned that a disease, in its aggravated form at least, to a species of fungus, it must not be implied that we are pre- to advise remedies or preventives. To determine these, one learn the life history of the parasite, its method of nutrition, h and propagation, and the varied forms or conditions under which ts its spores or fruit; the manner of distribution, exactly how upon or enters the affected plant, and its means of continuing s ce from year to year. These are all points of the greatest c and practical importance in this connection, and yet they are ry points about which the mycologist knows least. The reason is is that the vegetative portion of the fungus, the mycelium, af- v points for classification, so the systematic student has confined chiefly to the fruiting forms which present the more positive rs. When the fungus begins to show its fruit, however, the has passed beyond control, the mischief is done, for in most e mycelium has been long at work absorbing unto itself the pre- ces of the host plant.

s to the patient industry of a few scientific workers, chiefly s lents, the life history of a number of injurious fungi has trac . This is the case with the grape mildew (*Peronospora* t rose mildew (*Sphaerotheca pannosa*), so that these are no ar led foes they once were. Efficient remedies for keeping in check are now generally known.

is produced from a spore (seed), and wherever a fun- certain that its development was preceded by a

fall upon the leaves of the cedar, and, *vice versa*, those produced on the cedar will only vegetate upon the apple tree, or some closely-related plant. The conclusion naturally follows that if we would preserve our orchards from the attacks of the *Ræstelia* we must exterminate the red cedar that supports the "cedar apples." This is not an isolated example of alternation of forms upon different host plants; others are known, and it is probable that there are many yet to be discovered. Further information in this direction will no doubt suggest remedies for plant diseases that now seem wholly beyond our control.

Another way of checking the ravages of fungi is to destroy their so-called "winter spores," spores which are designed to continue their existence through the cold season. These winter spores are known only in a few instances, owing to the difficulty of tracing their formation. The winter spores of the grape-vine mildew are formed in the tissues of the leaves, probably also in the dead fruit when that is attacked, and in these they remain through the winter or until decomposition sets them free. It is now believed that the fungus which causes the American black rot (genus *Phoma*), maintains its existence through the winter in an acigerous form (the mature or perfect form of the *Phoma*) in the rotted and fallen grapes. From the consideration of these facts, the importance of destroying all the fallen grape leaves, berries, and trimmings from the vines, which are often allowed to remain where they fall, is sufficiently evident.*

In addition to these winter or resting spores, which resist the severity of the cold season and continues the existence of the fungus from one year to the next, there are many species whose vegetative portion, or mycelium, is perennial, living and continuing their growth more or less actively through the winter months in the tissues of the host plant. For obvious reasons fungi of this character are more difficult to destroy than the annual species.

There is another matter relating to the habit of growth of fungi that must be considered in connection with the employment of remedies for plant diseases, and this is whether they grow *within* the tissues of the host plant or only upon its surface. Those of the first class are by far the most numerous, and they are also the most difficult to contend with, for, when once established within the tissues of the host, little can be done to check their ravages.

The white mildew or blights (order *Perisporiaceæ*) includes species growing wholly upon the surface of the plants they attack. Unless occurring in great abundance they are not especially injurious, and they may be destroyed, if promptly attended to, with comparative ease. The mycelium consists of long cobweb-like threads which cling closely to the infested part, imbibing nourishment by means of small projections known as haustoria or "suckers."

The *Perisporiaceæ* produce two forms of spores. The mycelium at first sends up vertical threads or branches which divide into a number of squarish or ovoid cells. The topmost cell falls away and those below follow in rapid succession. These constitute the summer or *oidium* spores. They are so small and light that they are easily dispersed by the winds, and when they alight upon a suitable place they quickly germinate, and in this way the mildew is rapidly propagated.

Later in the season another and more complicated form of spore is

* The practical value of this vineyard clearing is shown by the experience of Colonel Pearson, who believes it to be the surest and most practical method of preventing both the black rot and the mildew. See article on "Grape rot and grape mildew," in this volume.

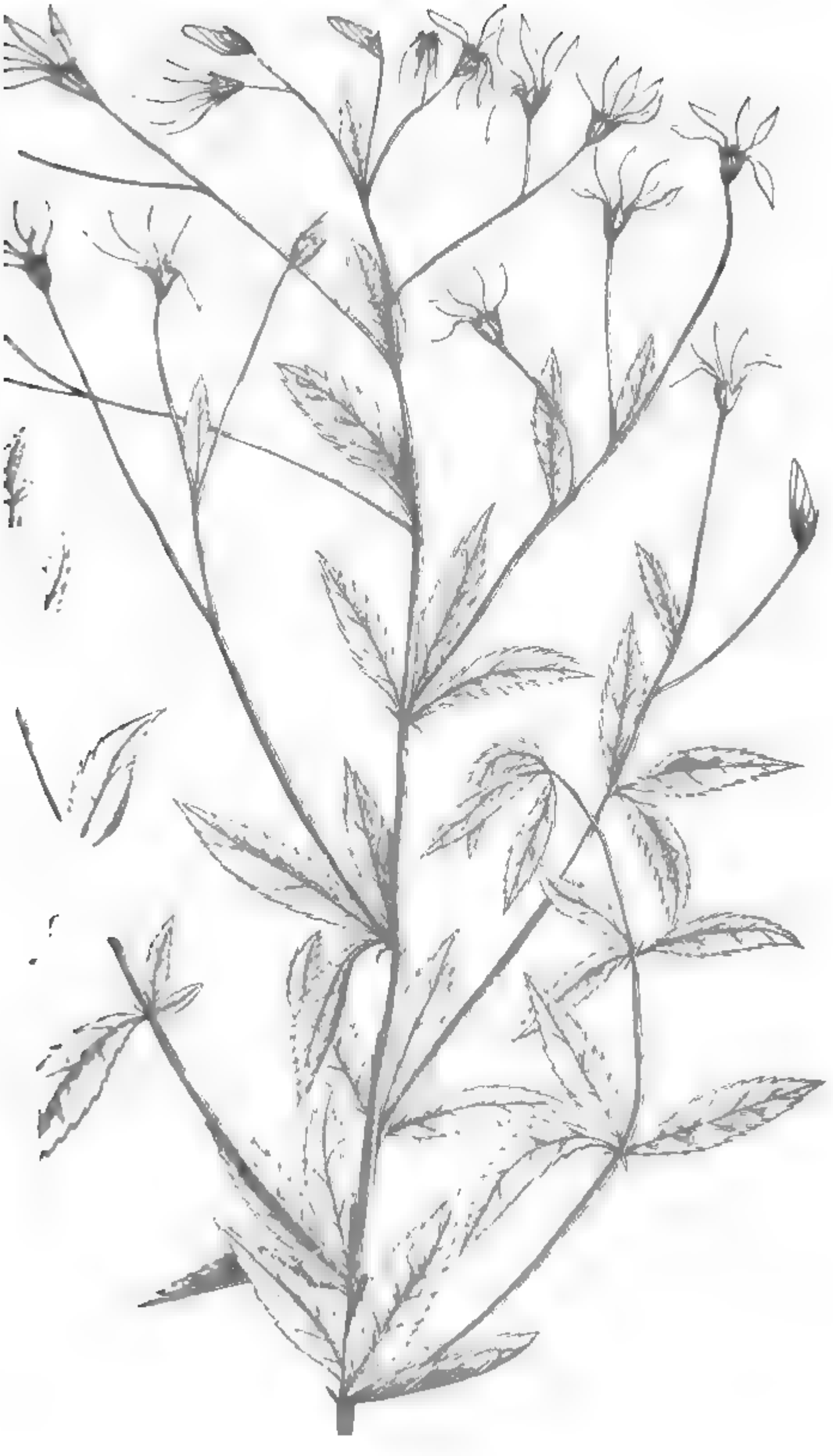
f the Botanist, Department of Agriculture, 1885.

JEFFERSONIA DIPHYLLA. (TWIN-LEAF.)

ILEX CASSINE. (YAUPON.)

RHAMNUS PURSHIANUS. (CASCARA SAGRADA.)

CASSIA MARILANDICA. (AMERICAN SENNA.)



GILLENIA TRIFOLIATA. (INDIAN PHYSIC.)

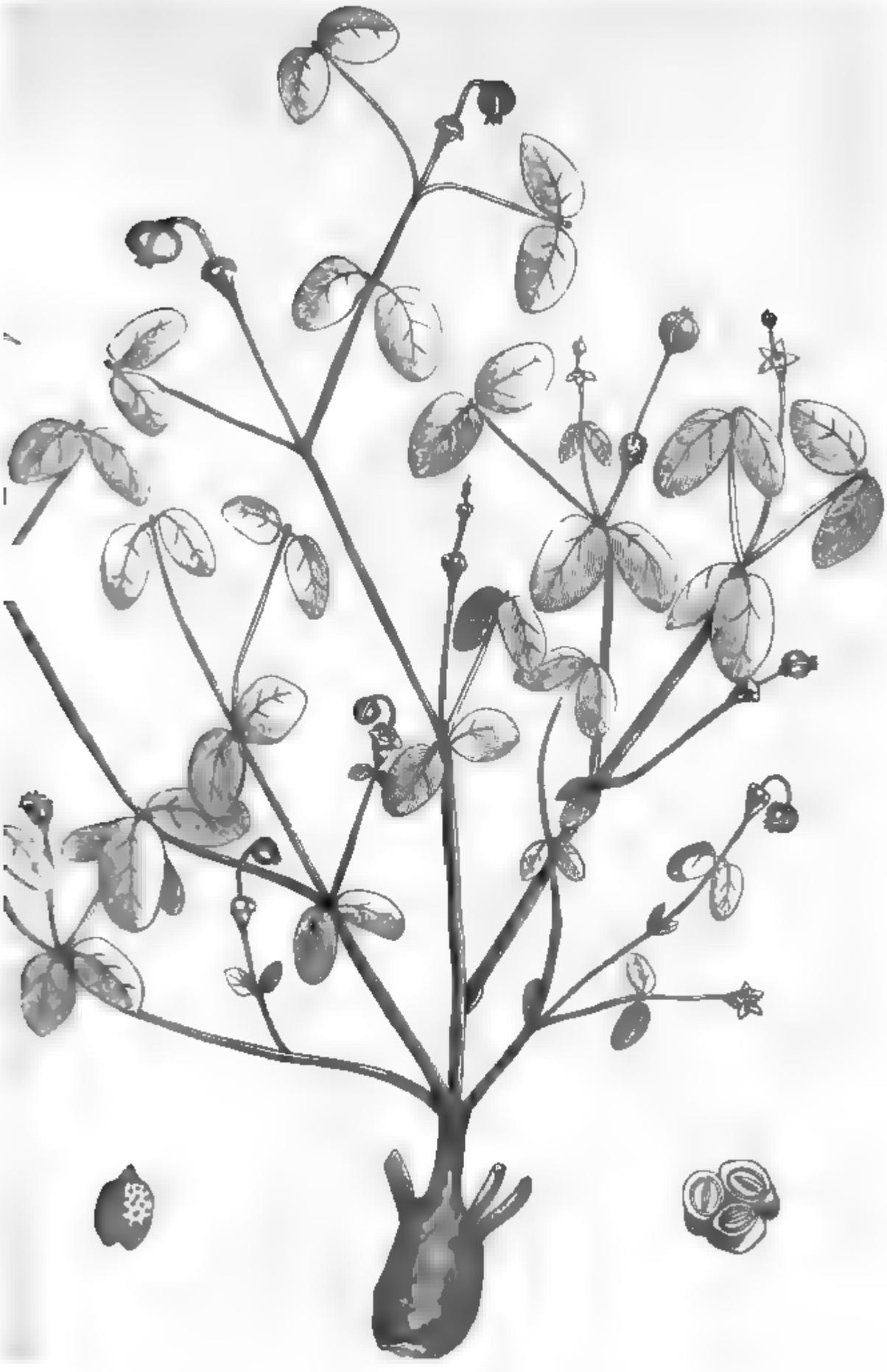
HAMAMELIS VIRGINICA. (WITCH HAZEL.)

LIQUIDAMBAR STYRACIFLUA. (SWEET-GUM.)

GRINDELIA ROBUSTA. (GUM PLANT.)

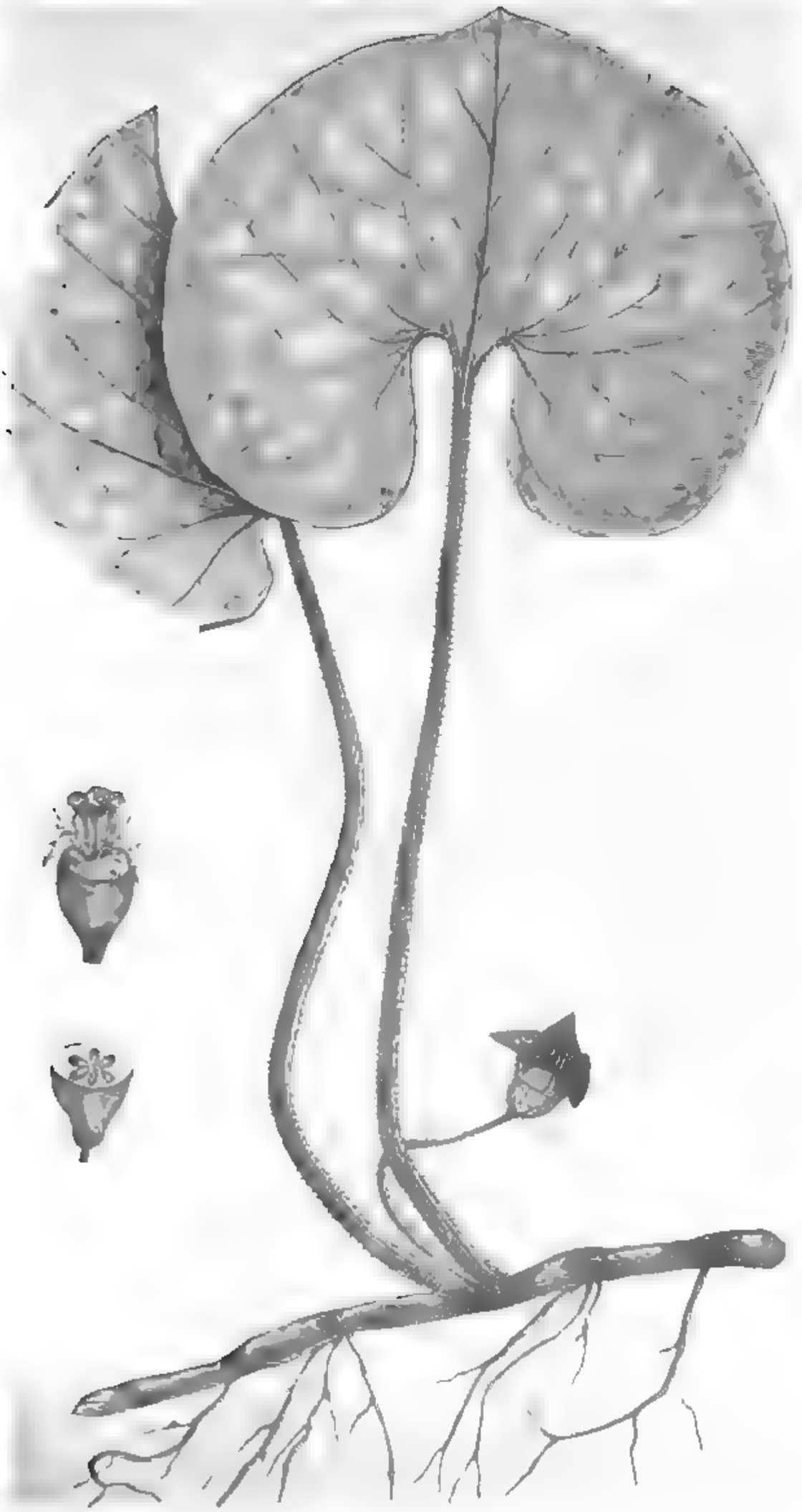
ERIODICTYON GLUTINOSUM (YERBA SANTA.)

EUPHORBIA COROLLATA. (WILD IPECAC.)



EUPHORBIA IPECACUANHÆ. (WILD IPECAC.)

ARISTOLOCHIA SERPENTARIA. (SNAKE-ROOT.)



ASARUM CANADENSE. (WILD GINGER.)

ANEMOPSIS CALIFORNICA. (YERBA MANSA.)

ARISÆMA TRIPHYLLA. (INDIAN TURNIP.)

SYMPLOCARPUS FŒTIDUS. (SKUNK CABBAGE.)

BLACK ROT OF THE GRAPE

(From an original photograph)

[Mr. A. W. Pearson, which this plate illustrates, will be published as a special bulletin.]

TILLETIA STRIÆFORMIS. (SMUT OF TIMOTHY.)

produced by a peculiar sexual process. These late spores are incased in firm covering, or *perithecia*, that serves to protect them from the exigencies of the winter season. Before the connection between these two fruiting forms had been determined the first was classified in a distinct group, designated under the generic name of *Oidium*. The early stage of the white mildew, often so injurious to our grape-vines, has been described as *Oidium tuckeri*, a species which has seriously ravaged the vineyards of Europe. Whether the *Oidium* of this country is the same as that of Europe has not been proven, but Dr. Farlow has shown that the so-called "*Oidium tuckeri*" of this country is only the summer or conidial state of a species of *Uncinula** (*U. spiralis*).

Oidium leucoconium bears a similar relation to the well-known "rose mildew" and "gooseberry blight" (*Sphærotheca pannosa*). In point of injury occasioned, this species is quite as injurious as the *Uncinula* of the grape-vine. It is a serious enemy to rose culture; it is reported as common on the peach in California and upon the cultivated raspberries in Iowa. From widely distant localities it is reported as doing much damage to the gooseberry, attacking not only the leaves but the fruit as well. We have received gooseberries from Utah almost wholly enveloped in the brownish felt-like growth of the mycelium of this fungus. Other species of this group prey upon the leaves of the cherry and apple or upon the foliage of various forest trees. One produces the white mildew, so common late in the season on the leaves of the lilac, another is injurious to the late-grown peas. It is needless at this time to further extend the list.

The specific for white mildews is the flowers of sulphur, and if used when the fungi first make their appearance, it will stay their ravages. This remedy is best applied with a bellows and when the affected plants are wet with dew or rain. The sexual spores are so well protected that when once formed they require a more violent remedy. The summer spores are naked and thin-walled and are easily reached by sulphur. The incased spores of late autumn, designed to carry the species over the winter, and the natural exposure of the leaves to moisture and frost, only prepare the perithecia for the escape of the spores. The placing of the infested parts in a compost heap would only aid in the preservation and distribution of the spores. The best method is to burn all mildewed parts of the plants and thus bring an end.†

Unlike most fungi, hot, dry weather appears to favor the development of the white mildew.

Many of the diseases of our fruit orchards might be remedied, or at least diminished, by raking together and burning the leaves as soon as they have all fallen. Within the substance of the leaves the spores of a number of injurious fungi are supposed or known to hibernate. Above all, these leaves should not be used as material for compost, for it is probable that this would only serve the better to preserve the vitality of the spores through the winter. The plan of raking up the leaves and burning them has been especially recommended as a means of checking the growth of the apple-scab fungus and the pear-tree scab. In respect to the latter disease, it is not confined to the leaves and fruit, but extends to the young shoots also. When the shoots are affected they must be removed with the knife and destroyed along with the leaves. Great care must be taken in selecting grafts. They should ver be taken from trees diseased with the scab, as it has been proven t the disease can in this way be transferred.

If this disease be taken early, say at the time of the formation of the ial or summer spores (the only spores so far known), the direct

* Farlow in Bull., Bussey Inst.

† Dr. Halsted, in Proceedings American Pomological Society, 1883.

application of some fungicide might prove beneficial. Exper alone will prove the usefulness of this.

The leaf-spot disease of the pear, or "leaf brownness," as it has termed, is a common disease here, and has been reported as being destructive in some parts of Europe. The fungus causing it is *thiera mespili*. It attacks the leaves and young shoots, and the w has observed it on the ripe fruits, spotting them badly.

As a measure against the spread and appearance of the disease experiment might be made of raking together and burning the le which have fallen from the diseased plants, and in the spring sev prune the naked branches provided with diseased spots, burning t cuttings also.*

The white rust of the strawberry, a wide-spread and well-kı disease, has caused serious loss to the growers of this fruit in se parts of the country. Mr. T. S. Earl read a paper on this and c diseases of strawberries before the annual meeting of the Miss Valley Horticultural Society, at New Orleans, January 16, 1885, Prof. William Trelease has given a very full account of the disease the bibliography, &c., in the second annual report of the agricul experiment station of Wisconsin, pp. 47–58.

Professor Trelease says that, so far as can be made out, the dise favored by hot, wet weather in early midsummer. It generally ap in its worst form soon after the berries are picked, and is often cially noticeable when a wet spell is followed by drought. Wha tends to lower the vitality of the plant is believed by some to pro the severity of the disease. The disease is caused by a fungus (*R laria tulasnei*), whose vegetative portion grows within the tissues o leaf, producing pale or whitish spots, surrounded by a dark-re brownish border. The spots have usually a roundish outline, and number varies with the extent of the disease. The summer spor conidia are developed on the white spots, imparting to them a fr appearance when viewed with a simple lens. These conidia are l upon short branches of the mycelium that project through the sto of the leaf, and being exceedingly small and light, are easily transp by the wind or other agencies from place to place, thus distributin disease. A winter state of this fungus is described and figure Professor Trelease in the paper above referred to. It appears as s black, egg-shaped bodies that protrude from both surfaces of the le These bodies are obviously compact outgrowths from the myc and correspond to the sclerotia, in which many other fungi, *e. g.* ergot of the rye and other grasses, pass the winter. By cultiv these sclerotia are made to produce spores exactly like the sui spores. In suggesting remedies for this disease of the strawberry, fessor Trelease states that it is advisable to select for the planting t varieties which have proved best able to resist its attacks, and cially to reject those which are notorious for spotting badly. dvantage may be hoped from a free use of lime, wood ashes, flo of sulphur, &c., when the disease first appears, as a great numb ne conidia may thus be destroyed and its progress possibly che When the plants are badly infested, the wisest course seems to ompletely destroy them by fire, after the berries are gathered et the ground with fresh and healthy plants.

There are few plant diseases that have caused more serious loss t

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*See Jacob Eriksson, "Contribution to the knowledge of the diseases of our plants." p. 75. [In Swedish.]

ter or horticulturist, or about which more has been said and writ- than those produced by members of the small order, *Peronosporeæ*. it forty species are known to occur in the United States, and, al- few in numbers, a glance at the injury they occasion will show he importance of a complete knowledge of their habits and method of evelopment. All the species, with the exception of those of the genus ythium, one of which is supposed to be the potting-bed fungus, so de- tructive to young house plants in the winter, attack living plants.

Potato rot, or murrain, is caused by *Phytophthora infestans*, better wn as *Peronospora infestans*. Wherever potatoes are grown, this to fungus is liable to occur. Last year it destroyed one-third of the to crop of New York State, and it is not uncommon to hear from ain sections of the entire destruction of the crop by this disease.

mbers of the family of plants to which the potato belongs also irom the attacks of this fungus. It is a serious enemy to the to- , both in this country and in England. W. G. Smith states that in districts in England, the out-of-door culture of the tomato has been stopped by the ravages made upon it by the potato fungus.*

ine vegetative system of the potato fungus grows within the tissues he leaves, stems, and even penetrates to the underground portions he plant, attacking the tubers themselves. This vegetative system with the death of the parts in which it grows. The part above is killed in the fall, but the mycelium that has entered the tubers retain its vitality and begin a new growth in the sprouts of the fol- year. Whether the disease is continued in this way is not posi- ely known. It is well known, however, that a peculiar form of spore, arly referred to as the resting or winter spore, is formed within the infested by the fungus. These resting spores may be found in l ayed tops of the potato, but they are especially abundant in the l tubers. Their office is to preserve the existence of the fungus n the winter. In the spring they germinate and produce a new of the fungus. The importance of totally destroying all parts of plants that have suffered from the attacks of the fungus is self evi-

There is another form of spore of the potato fungus that is pro- in the summer upon the under surface of the leaves of the infested t. When the conditions are favorable for the production of these r spores—conidia—the mycelium within the tissues sends out s into the air through the breathing pores—stomata of the leaf— t is upon these branches that the conidia are formed. The issuing se branches from the leaf impart to the lower surface a frosted ap- e. The conidia are produced in the greatest abundance, and ve crops rapidly follow each other. These conidia, falling upon es, quickly germinate, under the proper conditions of humidity, ine disease is thus spread from plant to plant and field to field, appearing over large areas with a suddenness that might ne attributed to magic or witchcraft by the uneducated.

e is no known remedy against the potato disease. No special sys- n culture can be relied on to prevent it. Mr. W. G. Smith, in his book on the "Diseases of Field and Garden Crops," treats at some upon the potato disease. He says:

revent the annual recurrence of the potato murrain, it is in the highest degree to destroy the material (dead tops, &c.) which is undoubtedly swarming with f disease germs. This destruction should be effected by burning, or, where s not practicable, deep burial might be resorted to; no more fatal mistake can

* Diseases of Field and Garden Crops, p. 275.

be made by potato-growers than leaving dead stems, leaves, and tubers abc fields, especially after a potato crop has suffered from disease. * * * Wit ject of prevention in view, hardy varieties which have not exhibited the disea be selected and reselected. They should be grown where possible in well-dra soil, and mineral manure should be used. As darkness, heat, and humidity a favorable to the growth of the *Peronospora*, all potatoes should be stored in dry, airy places in positions where light is not entirely excluded.

The grape-vine mildew, which has done so much injury to the vine in this country, and more recently to the vines of Europe, is by *Peronospora viticola*. The action of this fungus is well kno generally shows itself upon the under surface of the leaf, wh conidial spores are produced in great abundance. The winter are developed upon the mycelium within the tissues of the leaf they remain until spring. The ravages of this fungus are not c to the foliage, but sometimes extend to the berries themselves, ing a species of rot. Prof. William Trelease, in discussing the causes of grape rot (*see* Transactions of the Wisconsin State H tural Society, vol. xv, p. 196), says that the most destructive form disease in Wisconsin is a direct result of the growth, in the bei the fungus which causes the common leaf disease of the vine. T gus has been found growing with such luxuriance upon wild gr Iowa as to cover the whole plant with a white velvety growth affecting the vine as to prevent its reaching more than a foot height.*

The common Virginia creeper (*Ampelopsis quinquefolia*) ac host plant for *Peronospora viticola*, a fact recently discovered Farlow and Professor Trelease.

Writers having little knowledge of fungi have often confounc *Peronospora* of the vine with the mildew caused by *Uncinula* already referred to. The latter is confined chiefly to the upper of the leaves, and as it is wholly a surface-growing fungus it is injurious than the *Peronospora*, and is, moreover, less difficult tend with.

Many remedies for the disease of the vine due to the *Pero* have been proposed, but so far the most effectual specific kno solution of lime and sulphate of copper. It is made by dissol pounds of sulphate of copper in about 22 gallons of water; in vessel mix 34 pounds of coarse lime with 6 to 7 gallons of water, this solution add the solution of copper. A bluish paste will be sult. This compound, when thoroughly mixed, is brushed over the of the vine with a small broom, care being taken not to touch the This remedy, it is asserted, will not only destroy the mildew, b prevent its attacks.

Without going into a more detailed account of the diseases ca the *Peronosporeæ* at this time, we may simply add that onion mol to the attacks of *Peronospora schleideniana*,† lettuce mold to *I pora gangliformis*, the rose rot to *Peronospora sparsa*,‡ clover sick the mildew of clover to *Peronospora trifoliorum*; *Peronospora n* tacks the parsnip and allied plants, and *Peronospora parasitica* ious to turnips and cabbages as well as lettuce.§ Some of the named mitigate somewhat the evil they do by infesting l

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Dr. Halsted, in Botanical Gazette, vol. x, p. 338.

For an account of this disease of the onion, see first annual report of the n agricultural experiment station, pp. 38–44.

See The Gardener's Monthly for July, 1885.

See American Agriculturist, 1880, p. 148.

Peronospora effusa deserves a good word for confining its
one common pig-weed (genus *Chenopodium*).
ite rust disease of cabbages is due to a very common fungus
ler *Peronosporeæ*, named *Cystopus candidus*. It is especially
early in the season on the well-known shepherd's-purse and
ciferous weeds. Unlike the *Peronospora*, this cystopus forms
al spores beneath the epidermis, which, in consequence, is dis-
rming whitish pustules. When seriously affected the stems
s of cabbages and cauliflowers become swollen and distorted,
ed with white streaks and blotches as if bespattered with
h.
culture, and the destruction of those weeds that support the
question, together with a proper alternation of crops, will no
ck its ravages.
xime Cornu, in speaking of the mode of treatment for the dis-
sed by *Peronosporeæ** says, that when the entire plant is at-
should be got rid of at once; it is a hot-bed of infection. In-
ves should be removed, so that the plant may not contaminate
other plants; this should be done with precaution, in dry
when there is neither wind nor dew. Destroy as far as possi-
e seeds that may harbor the parasite, and all weeds that may
. All plants, or portions of plants, whether green or withered,
by the *Peronospora* or its mycelium, should be removed; the
tions, if left on the ground may, in damp weather, produce
res; the withered portions may contain resting spores, and
e a source of danger. They should be entirely destroyed,
nt or deeply buried. In no case should they be used for ma-
s food for domestic animals, as is often done.
has been said to illustrate the importance of the study of
ases due to parasitic fungi, and certain general principles in-
combating them have been pointed out. I may add that this
as a wider interest than pertains to our "field and garden
There are many fungi which are parasitic on our forest trees,
luctive of great injury, while others are no less injurious to
timber. And, finally, the subject is one of vast importance to
raiser, for there is no class of plants more often or seriously
by fungi than the grasses—the chief forage plants of the coun-
not only that the quantity of the forage may be seriously
u, but the quality is often impaired with even more serious
r it is well known that some of the diseases which have caused
s to the cattlemen of the West are due to the presence of cer-
in the grasses upon which the cattle feed.

HONEY-DEW.

dew is the term applied to a sticky, sweet-tasting, and nearly
substance found upon the surface of the leaves of many plants
seasons of the year, appearing like a smooth, uniform coating
over the surface, or in the form of yellowish, tenacious drops.
normally secreted by flowers or by special glands, and the
y-like substance found in connection with ergot in rye and
, are not here considered.
-dew in question may be produced by plant-lice (Aphides),
nus *Cocci*), or by what appears to be a genuine secretion
s themselves.

* Comptes Rendus, December, 1878.

Aphides, as is well known, are found upon a great variety of plants both wild and cultivated, and their power to secrete a sweet fluid nectar from the juices they draw from plants is also a well-known fact. This fluid is given off by these insects in great quantities, so that the leaves below those upon which they are stationed are often covered with the substance, and not unfrequently it may be seen actually falling from such trees as the maple or elm like a miniature shower, drenching all objects upon the ground beneath. The nectar thus produced has a sweet and pleasant taste, and unquestionably forms at times no inconsiderable portion of our best honey, for bees are very eager in gathering it. The honey it yields is light colored, has a pleasing taste, and is perfectly safe as a winter food for bees.*

It has been shown that various species of bark-lice (order *Coccidæ*) also form and excrete a honey-like substance, quite as copiously sometimes as do the aphides themselves, so that a like appearance is given to the plants they infect, the leaves sometimes fairly dripping with the nectar and the grass and walks beneath becoming sticky with the unctuous fluid. Bees also gather this nectar, but only when other fails, for they evidently do not like it. The honey produced is dark colored, has a disagreeable taste, and imparts an extremely unpleasant odor to the apiary.†

That honey-dew is oftentimes a true *excreta* from the tissues of the leaves themselves is proven by the fact of its appearance upon plants entirely free from all insects. Its production is not confined to excr glands, or to any set of organs, but takes place over the entire su of the leaves or fresh and green twigs, and may be regarded as a ver table disease. A great variety of plants have been observed to pro this honey-dew; among them may be mentioned the linden, poplar, willow, orange, olive, walnut, fir, and several species of maple. A number of shrubs and herbaceous plants may also be included in the list.

To what extent the production of this honey-dew is injurious is not well known. Sometimes the affected plants do not appear to suffer, but it has been shown that in some instances the leaves become discolo through the destruction of the chlorophyl grains in the cells, and t are also other changes that take place within the leaf in consequ of this. No further injury has been noted, yet indirectly it is liable t occasion serious damage, inasmuch as it may attract aphides and othe insects, as well as various kinds of parasitic fungi.

The composition of honey-dew, as given by Bossingault and Zoeller is 48 to 55 per cent. cane sugar, 28 to 24 per cent. of inverted sugar, and 22 to 19 per cent. dextrine. A little of the substance called *manna* has also been detected in it. This composition is exactly the same as that of the manna collected by the monks at Mount Sinai, upon the tamarisk stung by *Coccus manniparus*.

Very little is known as to the cause of this malady. It appears most frequently in hot, dry weather, more particularly on plants that are exposed to the direct rays of the sun. Some think that it may be due to the nature of the soil in which the plants grow; others that it is

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* Science, January 23, 1885.

† Mr. H. S. Hubbard, of the entomological division of the United States Department of Agriculture, has observed several species of leaf hoppers (genus *Proconia*) upon the cotton-plant and the pear tree, which secreted a sweet substance similar in nature to that produced by aphides. They possess the power of ejecting the fluid from their bodies with considerable force. This is done at short and regular intervals, and the quantity thrown out is often sufficient to cover the leaves and the objects on the plants, making them appear as if wet with dew.

p ıliarity of certain individuals, for among a lot of diseased a v may be found in perfect health; while others again attribute t w) alteration in or wounds of the roots. There is nothing known f the true cause, however, beyond these and other like unattested heories; neither is there any known remedy for the disease.

THE SMUT OF TIMOTHY.*—(*Tilletia striæformis*, Westd.)

In y and June my attention was called to the prevalence of dis- es on the timothy about Madison, Wis. The affected plants at this time somewhat smaller than those that were not diseased, lly 4 to 5 inches high, with only three or four developed leaves: other- they presented no unusual appearance when carelessly handled. al examination, however, one or more of the leaves were found e marked by lead-colored, slightly thickened lines, about one-sixty- h inch wide and one-sixteenth to one-fourth inch long, running thwise of the leaf.

times but a single line or a series of lines was to be found on a out usually there were several, in many instances the space be- the two veins of the leaf being occupied by those discolorations, tended from the base nearly to the apex (Fig. 1). When one se leaves was cut or torn across, it was found that each of the -colored lines referred to corresponded to a black, dusty mass, oc- ing the center of the leaf, and merely covered by the epidermis at top and bottom. Shortly afterwards the epidermis ruptured along lark lines, one side usually tearing before the other, and so exposed ooty substance, which was shaken from the cavities and dispersed by the wind, under the action of which the leaves were soon reduced to n shreds, by which the diseased plants could be readily distin- even from a distance (Fig. 2).

Under the microscope the dark mass filling the leaf-cavities was found st of numberless irregularly round or ovoid, pale-brown spores, by measuring 10 to 12 μ. in diameter, their surface closely beset with short spines (Fig. 3).

In its appearance to the naked eye, and in its microscopic characters, it agrees closely with *Tilletia de baryana*, F. de Waldh. distrib- on *Holcus mollis*, from near Berlin, in Rabenhorst's Fungi Europæi, No. 3393. It is also indistinguishable from the English specimens of *Ustilago salveii*, B. & Br., on an unnamed grass, in Cooke's Fungi Britt. Exsicc., No. 57. These species are held to be identical by Schrœter and Winter,† who replace these, together with other other synonyms, by *Til- letia striæformis* (Westendrop).

The species occurs in Europe, in the leaves of *Agrostis stolonifera*, *A. vulgaris*, *Calamagrostis halleriana*, *Milium effusum*, *Holcus lanatus*, *H llis*, *Arrhenatherum avenaceum*, *Briza media*, *Poa pratensis*, *Dactylis ata*, *Festuca ovina*, *F. elatior*, *Bromus inermis*, and *Lolium perenne*. e collected it in Wisconsin, in the spring, on timothy (*Phleum pra-* and on the glaucus wild rye (*Elymus Canadensis*, var. *glaucifolius*);

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* chapter, on a disease of the most important meadow-grass of the Northern has been prepared at the request of the assistant botanist of the Department, lliam Trelease.

r: Cohn's Beiträge, zur Biol. der Pflanzen, 2, pp. 366, 367.

Pilze, in Rabenhorst's Kryptogamen-Flora, 1, p. 108.

and in Massachusetts, during the summer, on quack* grass (*Tritici repens*). Though most abundant on the leaves of young plants, it is n confined to them, but has been found as well on flowering specimens timothy and quack.

When as abundant as it was about Madison and other parts of W consin, in 1883 and 1884, the timothy smut is the source of conside able direct loss, by lessening the yield of one of the most valuab meadow grasses. Its relationships are also such that it is open to th suspicion of being injurious to animals which are fed on plants attacke by it.

During the winter of 1883–'84 considerable excitement was create by the appearance of what was supposed to be "foot-and-mouth d ease" in Kansas cattle. The disease was investigated by the veteri arian of the Department of Agriculture, who traced it with certaint to ergotism.† In the report on this examination it is stated that " ilar cases which occurred about the same time in other localities wer cases of ergotism. Professor Law, of Cornell University, Prof Stalher, of the Iowa Agricultural College, and Professor Faville, of t Colorado Agricultural College, have seen similar cases in their re ive States, and concur in the opinion that they are due to poi from ergot."‡ During the present year Dr. Atkinson, State vete arian of Wisconsin, found cattle in that State suffering from a simil disease of the extremities, which he is inclined to attribute to ergo as he has informed me, and cases of the same sort are recorded in other localities. Many instances of abortion are also unquestionab attributable to the presence of ergot in hay or pasturage.

For a number of years the smut of Indian corn (*Ustilago z* has been growing in favor as a substitute for ergot in medical p since it possesses active properties similar to those of the latter su stance. So far as I know the smut of timothy has never been examin chemically, nor have experiments been instituted to determine its a tion on the animal system; but until it has been shown to be ha it will be safe to regard it with suspicion, and to avoid pasturing g or feeding hay that is known to contain much of it.

In conclusion, it may be well to extend the same caution to anot smut (*Ustilago panici glauci*, Wall.), which is very abundant in autu in the ovaries of the rusty pigeon grass (*Setaria glauca*), which, thou generally regarded as a weed, is said § to furnish "a considerable amou of fodder which is as nutritious as Hungarian grass, but not as pr ductive."

GEO. VASEY,
Botanist.

Hon. NORMAN J. COLMAN,
Commissioner.

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* Specimens were distributed on this host in Ellis' N. Amer. Fungi, No. 1498.
† Report of the Department of Agriculture, 1884, p. 222.
‡ *l. c.*, p. 224.
§ Vasey: Agricultural Grasses of the United States, p. 43.

REPORT OF THE MICROSCOPIST.

SIR: I have the honor to submit herewith my fourteenth annual report. The work of this division for the past year has been chiefly confined to the detection of adulterations of food, with special reference to the oleomargarine, butterine, and the fats used in the manufacture of margarine cheese, having in view the discovery of a method by which the respective fats employed in the manufacture of butter substitutes may be detected with the microscope, thus assisting to render effective the law relating to this subject.

Chemical methods of testing butter and fats are found to be necessarily slow and not always satisfactory, as is affirmed by the leading chemists of Europe and America. Prof. A. Voelcker, chemist of the Royal Agricultural Society of England, recently acknowledged before a parliamentary committee that the reasons why the butter laws of England were wholly inoperative was because there was no chemical test known to him whereby oleomargarine could be distinguished from butter.

In considering the fact that every known fat, vegetable and animal, presents to the touch and sight different physical properties, I became convinced, fats being composite bodies, that the proportions of their fatty combinations might vary and give rise to different forms of crystalline structure. Experiments have thus far demonstrated the correctness of my theory.

Agreeably with your instructions I was present at the annual meeting of the American Society of Microscopists, held at Cleveland, Ohio, in August last, and read a paper on the crystals of butter and other animal and vegetable fats, with illustrations on the blackboard.

In consequence of the novelty and apparent value of the facts stated, and the discoveries which are the result of years of patient investigation, the president of the society, Prof. H. L. Smith, of Hobart College, Geneva, N. Y., with my sanction, appointed a committee of five experienced in microscopy, to investigate and report upon the merits of the discoveries. On the following day the chairman of said committee stated publicly, at the morning meeting, that I had verified the statement made. The full report of this committee will be published in the society's annual report.

I also read a paper before the chemical section of the American Association for the Advancement of Science, held at Ann Arbor, Mich., the month of September, an abstract of which is now published by the society.

By invitation of the president of the American Textile Society and agreeably with your instructions, I prepared and read, at the annual meeting in October, a paper relating to the structure of textile fibers and the changes effected thereon by the action of chemical reagents. A report is included, as the experiments were originally a part of my chemical division work.

TEXTILE FIBERS.

The division is frequently called upon to make investigation as to character of textile fibers and fabrics, not only for the public gener but also for several Departments of the Government.

Textile fibers are presented as articles of manufacture and in the In the former case they may have been dyed, stained, or painted. obvious that under these conditions the fibers should be submitte chemical reaction to bring them as nearly as possible to their nor condition.

Considering how well the structures of the common textile fiber commerce—cotton, flax, ramie, jute, manilla hemp, silk, and wool—l been investigated and minutely described by able and exact micros ists, I will here confine myself chiefly to such experiments as I l personally made with such fibers, treating them with chemical re-ag while under the objective.

While aware that this method is not wholly new, I am satisfied comparatively little work has been done in this direction, and th wide field is still open for future research.

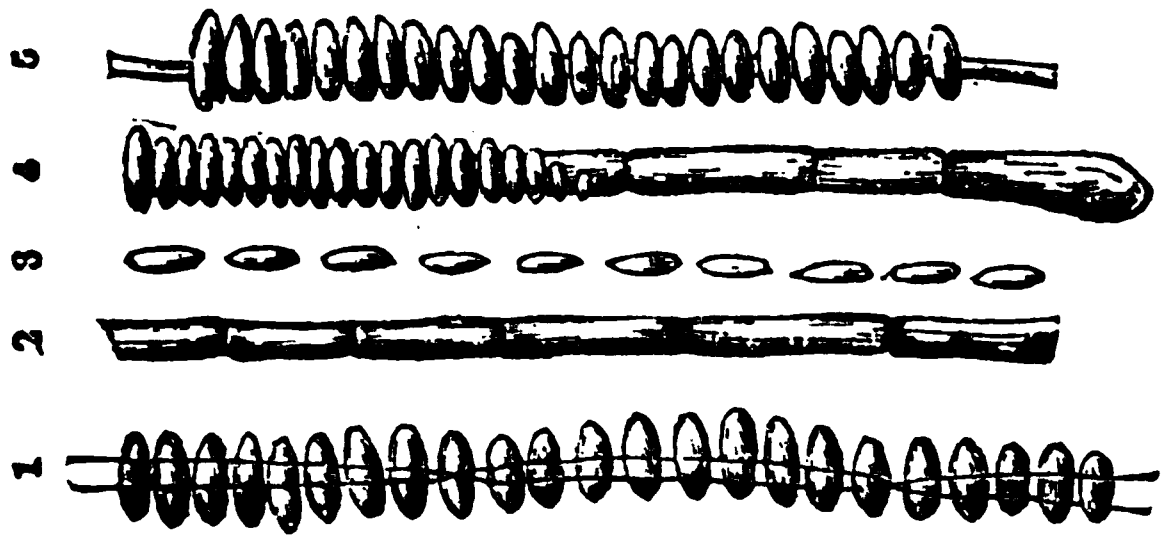
Microscopists have to fortify themselves in every way that will tain, by truthful work, the value of the microscope as a means o search, sometimes conducting their experiments under the most tr circumstances. Fibers may be so treated by experts as to make it cult to determine how their changed appearance has been effected, it may happen in this age of experiment and speculation that impor decisions in commercial transactions and in criminal causes may de upon their investigations. A case in point will illustrate this: W Dr. Dyrenforth was in charge of the chemical division of the Ur States Patent Office, a person applied for a patent on what he c "cottonized silk," furnishing specimens. The applicant claimed to invented a method of covering cotton fiber with a solution of silk w could be woven into goods of various kinds. In order to satisfy public of the reality of his invention, he placed on exhibition in var localities specimens of silk-like goods, in the web, in skeins of thr and in ribbons, representing the same to be "cottonized silk."

Dr. Dyrenforth, not convinced of the reality of the so-called inven forwarded to this division some fibers of the material for investig These were subjected to the usual tests, and the fibers were foun consist of pure silk. The fact was so reported, and the application rejected. The microscope was thus usefully employed to protect m facturers and the public from imposition. It may be well to state br the methods employed in detecting the real character of the mat The fibers were first viewed under plain transmitted light, secondl polarized light and selenite plate. Since silk and cotton are polar bodies, "cottonized silk," if it could be made as described, would in this case, the prismatic colors of both fibers, and the complemer colors would differ greatly because of the great disparity of the spective polarizing and refractive powers. The fact will be obse that a fiber of cotton presents the appearance of a "twisted rib when viewed under the microscope, while a fiber of silk, owing cylindrical form, cannot twist upon itself.

Again, the diameter of "cottonized silk," so called, would necess be greater than that of a fiber of silk, since by reason of the short of the original hairs of cotton fiber the silk solution would have applied to an actual thread of cotton and not to a single fiber. W single fiber of such combination put under a suitable objective,

of nitric acid brought in contact with the fiber, it would be seen
acid would destroy the silk and leave the fibers of cotton un-
the latter being insoluble in cold nitric acid. The action of
acid is similar.

re a fiber of cotton present, and a drop of pure sulphuric acid
on it, followed quickly by a drop of a transparent solution of the
ire of iodine, a peculiar change in the fiber would be seen to take
, provided the right proportion of acid be used. Cotton fiber, un-
uch conditions forms into disks or beads of a beautiful blue color,
he same effects are still more conspicuous when the fiber of flax is
l to the same treatment. Fig. 1 represents a fiber of cotton, and
2, 3, 4, 5 fibers of flax, as they appear under such treatment. Every



amylaceous fiber is more or less convertible into these forms by
sulphuric acid. The fibers of cotton, flax, and ramie are ex-
s of amylaceous cellulose; that is to say, these fibers are converted
rchy matter by treatment with sulphuric acid. Therefore in
ations of these fibers with non-amylaceous fiber (ligneous or
fiber) the former will be dissolved, leaving the latter unchanged;
body fibers remaining will prove suitable objects for microscopical
ations.

n, it might be important to know whether a certain pulp or com-
on contained flax in combination with cotton. The composition
be of such a well-digested character as to destroy all appearance
mal form, that is to say, the "twisted ribbon" character of cotton,
l as the cylindrical and jointed characteristics of flax, might be
ordinary view. In this case, make a watery solution of the pulp,
l it out thinly on a glass slide 3 by 1 inch, draw off any superfluous
, then add one or two drops of a strong solution of chromic acid,
lace over it a glass cover. When viewed under the microscope
ortion of the joints of flax present will appear of a dark-brown
A solution of iodine has a similar effect. The brown portions of
ints being nitrogenous, are stained a yellow color by the re-agents
l, while the fibers of cotton, which are devoid of nitrogen, remain
ined. The fibers of flax may be chemically treated so as to render
of a beautiful white, silky appearance to the naked eye, but, when
ned under the microscope, the brown nitrogenous matter of the
is found still present, and on using the chromic acid test it be-
eply stained. A chemical solution of flax, therefore, would
r some purposes, undesirable, owing to the presence of this
tter. Cotton being destitute of ligneous matter will give a
pure solution and is on this account better adapted than flax
compounds.

that when wool is treated with the sulphuric acid of com-
strong diluted sulphuric acid, the surface scales of the fiber

are liberated at one end and appear, under a low power, as hairs proce ing from the body of the fiber. Wool may remain thus saturated in t acid for several hours without appearing to undergo any further chan as far as is revealed by the microscope. When treated in mass in bath of sulphuric acid, strength 60° B., for several minutes, and aft wards quickly washed in a weak solution of soda and finally in pu water and dried, it feels rough to the fingers, owing to the separati of the scales. I have preserved a small quantity of wool thus treat for the last twelve years, my object being to ascertain whether the chem cal action to which it was exposed would impair its strength. Wool th treated seems to possess the property of resisting the ravages of the larv of the moth. This specimen, although openly exposed for the peri named, suffered no injury, while the imbrications appear to have r sumed their natural position and appear finer. From these experimen it would seem not improbable that a new article of commerce mig profitably be produced, as wool thus treated seems to be moth-proof.

It is found in practice that when sable brushes are washed in a we solution of pure phenic alcohol, and afterwards in warm water, t moth worm will not eat them. I mention this chemical fact because shows that a change of this material is brought about by the phenol to its edibility, and this may explain why wool treated with sulphu acid is rendered moth-proof.

The fibers of dyed black silk may be viewed with interest under t microscope. If a few threads of its warp are placed on a glass slide a one or two drops of concentrated nitric acid placed in contact with th the black color changes first to green then to blue, a lifelike motion observed in all the fibers, they appear marked crosswise like the ri of an earth worm, the surface of each fiber appears loaded with pa ticles of dye-stuff, and finally the fibers wholly dissolve in the acid. we now treat a few threads of the weft in the same manner, a simil change of color takes place. When the fibers assume the blue color, dark line is observed in the center of each running longitudinally t whole length (which dark line is doubtless the dividing line of the t original normal threads formed directly by the two spinnerets), t dark air-line or shadow finally breaks up, and in the course of a f minutes the silk is wholly dissolved. Were ramie, cotton, flax, or her present, they would be observed, as all these fibers remain unchang under this treatment. If wool be present, rapid decomposition will f low, giving off copious fumes of nitrous acid, allowing, however, sufficie time to observe the separation of the scales of the wool fibers and demonstrate by observation under the microscope that the fibers a those of wool. In making these experiments it is not necessary to us glass disk over the treated fibers. If a disk or cover is pressed on th while undergoing this treatment the lifelike motion of the silk will n be so apparent.

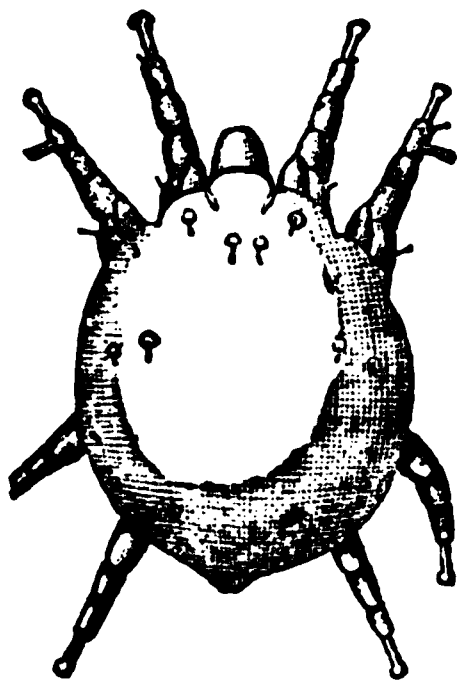
PARASITES IN DOMESTIC FOWLS.

I have incidentally examined several sick domestic fowls in order ascertain their ailments. The first examined was in a moribund co dion when received, and died within an hour after it was brought to notice. Its comb was of a deep red color, abnormally so, the tips bei somewhat black. On dissection, its general viscera presented nothi peculiar, but on removing that of the thorax and abdomen, the lu excepted, I observed, on the intercostal muscles bordering the ribs, wi resembled a superficial reddish pigment, in streaks, while small spec of various forms covered the lining of the abdominal cavity. These

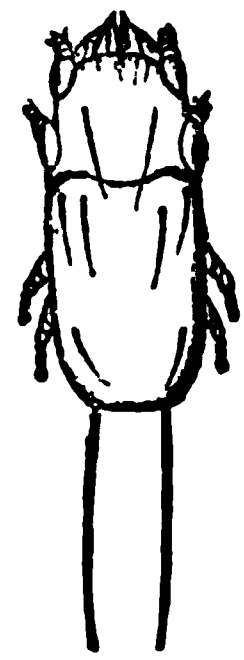
om the size of a pin point to that of a small pin head. On removing ll portion of this colored substance, and viewing it under a suitable of the microscope, I found it to consist of living mites (*acari*), in ges of growth. I next removed a small portion of the lung , placing it under the microscope, again discovered several mites. Another portion was removed from the lungs, not exg half a grain in weight, when three more mites were discovered. last were so lively that it was difficult to keep them long in view at changing the glass slips on which they were placed.

nite closely resembles *Cytoleichus sarcoptoides* (Mègnin), although es has not hitherto been found in such habitats as above de-

Mègnin states that the *Cytoleichus sarcoptoides* causes the death n wild and domestic fowl: "They are found in the air-passages lungs, in the bronchial tubes and their divisions, in the bones with the air sacs communicate, and in other cavities. They are also in the bronchi of birds, and, when they are extremely numerous, titillations of the bronchial mucous membrane, indicated by a cough, in some cases causing symptoms of asphyxia and congesto which the birds may succumb." He instances an example in the of a pheasant, in which, when dissected, this obstruction of the hi was well manifested. (See cuts 1 and 2.)



Cytoleichus sarcoptoides.



Laminosioptes gallinorum.

k it probable that these mites, after they have effected a lodgm the lungs, bore through the pleura and invade the thoracic and nal cavities, where they breed in large numbers, producing great ion and ultimately death.

it two months after the first dissection, a second fowl in a moricondition was brought to me by the same gentlemen who brought st. The comb of this fowl was highly engorged, and the tips were Its crop was greatly distended. It was unable to stand up, ed with difficulty, yet exhibited considerable strength when about killed. It had been sickly for the previous four weeks. I took tion in this case to remove the skin, so that I could examine ular tissue, when I observed great numbers of small, white, specks, of various dimensions, varying in size from the one-hunan inch to the one-twelfth of an inch in diameter. When ler the microscope, the tissue showed within its folds and cell nu rous mites, which proved on examination to be *Laminorum* (Mègnin).*

* determination of these Mites I am indebted to Dr. C. V. Riley.

Further investigation showed that the opaque markings above alluded to contained, in many instances, the remains of one or more of these mites. The substance of the opaque specks was calcareous. The habitat of these mites seemed to be confined to the cellular tissue wholly. I examined the viscera and cavities of this fowl, but found neither living mites nor their remains nor calcareous specks. Megnin states that in Europe this acarus has been found in all turkey hens, and especially in foreign turkeys of the family *Phasania*. He says that these acari gather in millions in the cellular tissue and destroy the fibers, but without causing any other change than the production of the calcareous concretions spoken of. He further says: "They have been noticed in such numbers in old birds as to leave no doubt as to their being the cause of death." The existence of either of the mites above described in American fowl has not hitherto been known. In this same fowl I found thousands of encysted nematoids, resembling, when viewed under a low power of the microscope, trichina spiralis; but when removed from their watery cysts and viewed under a power of about 500 diameters, they seemed to be of an undescribed species.

These encysted worms are wholly confined to the muscular coating of the stomach and intestines.

On examining a third fowl, which was dead when brought to , I found in its cellular tissue numerous mites of the species *gallinor* , above described. From the results of these examinations, it se probable that a considerable amount of disease prevailing among American domestic fowls and not referable to any known type, may be due to the presence of such parasites as I found in the cases above mentioned. Investigation in this direction may therefore have an important bearing on the healthful raising of domestic fowls.

I would suggest that carbolic acid, or other disinfectants, sprinkled in and about nests and on the floors of henneries, might prove useful as an antidote in cases similar to the above, as well as in cases where the exterior of the fowl is infested. Since this discovery was made, a Western correspondent, Mr. T. B. Redding, writes from Greencastle, Ind., that the identical species of mite described above has been found in domestic fowls in his locality.

FUNGI.

I have prepared a collection of water-color drawings, numbering abou eight hundred plates, representing the leading types of the gene species of fungi, embracing many of the edible and poisonous spec found in the United States, together with the types of genera an species of the principal microscopic fungi which prey on living plant or are otherwise prejudicial to their healthy growth.

The edible fungi of the United States at present known consist about one hundred and thirty species. Mycologists and others interested will probably find in this exhibit a larger number of drawings native species than can be found elsewhere.

The microscopic fungi are selected from collections made by Dr. M. C. Cooke, Prof. Charles Peck, Dr. Curtis, and other noted mycologist many of them having been prepared especially for this division. have also prepared a descriptive catalogue of this collection.

TESTS OF BUTTER AND OTHER FATS.

A little over eight years ago I made my first experiments relating oleomargarine and butter, my prime object being to find a mode by which these substances could be distinguished one from the oth

occasion for experiment has since been afforded, in tests of
ıples of uncertain or suspicious origin, and I have made the
that when it is boiled and cooled slowly for a period of
y-four hours, at a temperature of from 50° to 70° F., it not only
ıes crystallized, but, with proper mounting and the use of polarized
it exhibits on each crystal a well-defined figure, resembling what
:n as the cross of St. Andrew. In course of time, the period
ıg from a few days to a few weeks, according to the quality of the
used and the temperature to which it is exposed, the crystals,
at first are globular, degenerate, giving way to numerous rosette-
ırms peculiar to butter.

ıve also demonstrated that the crystals of butter and lard re-
ɾely differ essentially from each other, and may be distinguished
one from the other, when properly prepared. The crystals of
made butter, when boiled, are globular and present a dotted ap-
ıce, due to the projection of numerous short spines. Those of
ıave long biserrated spines proceeding from a common center,
lard gives a strictly stellar or star-like form, proceeding from a
opaque center, which appears to be granulated.

se new facts led me to experiment with other fats, vegetable and
l, with a view to determining whether the fats of other animals
vegetables may not have other crystalline forms peculiar to them-
and of such definite structure as might lead to their detection
fraudulently combined with other fats in medicinal compounds,
have made numerous experiments to that end, and have found
ıe normal crystals of several fats, which have not heretofore been
ıed with sufficient accuracy, may be distinguished from all others
ır examined. For example, cacao butter, when its consistency is
ıch reduced with sweet oil, gives a most beautiful and perfect
crystal. Spermaceti, white beeswax and paraffine, treated in
ə way give other forms, but as yet I am unable to obtain the
crystalline forms of these last-mentioned fats.

utility of these investigations in animal and vegetable fats may
ırred from the fact that in each of the prosecutions lately brought
fraudulent butter dealers and venders, in the city of Washing-
ıe accused, in every instance, acknowledged that my evidence
them was correct, and that they had sold tallow compounds as

ı result of this detection of fraudulent compounds, about sixty
rs, men and women, who, under the guise of farmers, have been
g for sale, from door to door, compounds of tallow, lard, and cot-
ɔd oil, mixed with inferior butter, as genuine creamery butter,
baudoned their calling.

EXAMINATION OF BUTTER AND ITS SUBSTITUTES.

ıaking examinations of butter and its substitutes, a specimen of
spected article is placed between two small pieces of glass, using
the ordinary microscopic slide 3 by 1 inch, and for the other a
:oscopic disk; then compress the specimen sufficiently to give
ıranslucent cloud. If white opaque particles are observed be-
glasses, there is reason to believe that the substance is a
pound. If the experimenter will first practice with lard in an
of moderate temperature, he will observe the white specks
to. Should the cloud be very even throughout, it is
pure butter or newly-made butterine.

Before proceeding further with the microscope a portion of the s
ples is usually submitted for examination to a test with sulphuric a
While these two simple tests will always distinguish true oleoma
rine from butter their result is less decisive in the case of butter
owing to its containing a considerable proportion of butter. Hen
is often necessary to subject what appears to be genuine butter
closer examination. When this is the case, resort is again had to
microscope, first removing any salt present by pressing a portion of
substance through the meshes of fine cambric muslin, then moun
the specimen with as little friction as possible, and viewing it by p
transmitted light under a power of about 75 diameters. If well-defi
crystals of fat are present they are at once seen. Should the crys
be in the amorphous state they may not be seen in this way. I t
resort to polarized light when very minute fatty crystals are at
detected, if present, provided the polarizer is rotated until its face a
is at right angles with that of the analyzer. Push the polarizer d
as low as the stand will permit. By this means a darker groun
produced, and the bright specks or light shades of fat will app
view over the dark ground.

When amorphous crystals are detected by this means it is desirabl
ascertain whether they are of beef or lard.

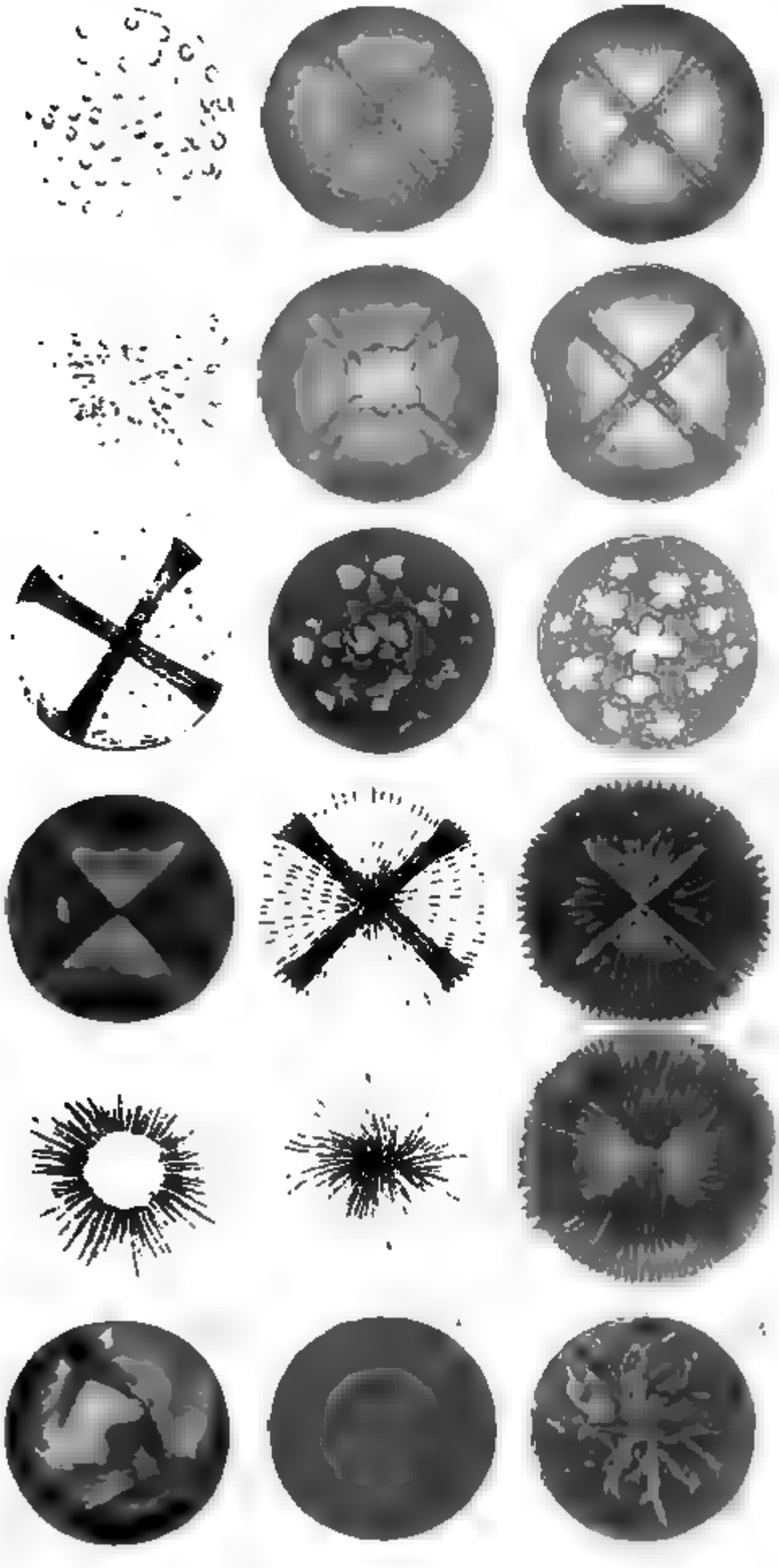
Boil about 1 ounce of the substance and cool it slowly. The
step is to examine under the microscope a portion of it thus prepa
To accomplish this it will be necessary to prepare by any of the
known means on a glass slide of 1 by 3 inches, a varnish ring one
dredth of an inch in thickness when dry. Put a single drop of
thick, transparent oil within the varnish circle and place in contact
the oil a very small portion of the suspected substance. Use a p
such as that of a pin or needle, to separate the floating fatty subst
into very fine granules (crystals). Place a suitable glass disl
"cover" over the oil and press it gently down so that it will com
contact with the varnish ring, which should receive one coat of var
just before the slide is used and should be of sufficient thickn
protect the crystals from pressure by the cover. The object may
be viewed by plain transmitted light. If the crystals exhibit a
defined stellar form, such as Figs. 13, 14, or 15, the substance is l
if such as 18 it is beef fat. The latter should be viewed with the
powers, so as to observe the biserrated form of the individual spin
which the perfect crystal consists. If butter crystals are present,
may be of one or both forms, globular or rosette. (See Figs. 7, 8, 9,
5, PLATE 1.)

In PLATE I, Fig. 1 represents the crystals of boiled butter as see
a pocket lens: Fig. 2, highly magnified crystals of butter from a b
of Shorthorn, Devon, and Tennessee native cattle, showing the "cr
under polarized light; Fig. 3, crystals of butter from a breed of
Alderney; Fig. 4, highly magnified crystals of Tennessee butter u
plain transmitted light; Fig. 5, a budding crystal of Tennessee bu
Fig. 6, the indented crystal peculiar to Tennessee butter of this gr
Fig. 7, a crystal of butter from Huron County, Ohio; Fig. 8, the ro
form of secondary crystallization of butter as seen under polarized
and selenite plate; Fig. 9, secondary crystallization of butter unde
larized light without selenite plate; Fig. 10, a crystal of butter u
polarized light and selenite plate; Fig. 11, a crystal of oleomarg
under polarized light, in which sample a large proportion of butter is
bined with lard, the presence of butter being indicated by the "cr
and that of lard by "spines"; Fig. 12, the same crystal under polar

CRYSTALS OF FATS, BUTTER, BEEF & LARD

Representing Butter, Oleomargarine & Butterine

PLATE I



light and selenite plate; Fig. 13, pressed lard under transmitted light; Fig. 14, rendered lard, strained to remove nitrogenous bodies; Fig. 15, the same crystal under polarized light and selenite plate; Fig. 16, homogeneous olemargarine under polarized light and selenite plate; Fig. 17, pure butter under polarized light and selenite plate; Fig. 18, beef fat highly magnified under polarized light and selenite plate. The magnifying power employed in the investigation of the above crystals, with the exception of Fig. 18, varies from ten to five hundred diameters, and in Fig. 18 from seventy-five to five hundred diameters.

TO SEPARATE BUTTER CRYSTALS.

The method employed to crystallize butter and separate the crystals, so that they may be seen by the naked eye, is this: Procure a specimen of pure butter and boil it in a test tube or tin pan for a period of several seconds, pour the liquid portion off in a cup or other suitable vessel, and put it in a cool place to crystallize; allow the cooling process to continue from twelve to twenty-four hours. Remove with the point of a penknife a few grains of the butter thus treated, place it on a slip of glass and pour over it a few drops of alcohol. The crystals may then be easily separated from each other by means of a needle. A solution of alcohol in a concentrated solution of pure carbolic acid in the proportion of ten parts by measure of the first to one part of the last, will prove more satisfactory in separating the crystals than alcohol alone. If the crystals are viewed by a pocket lens they will appear like so many insect eggs. (See Fig. 1.) Beef and lard fats may be treated in like manner, but in practice it will be found that the crystals of these fats are not so easily separated, owing to their long spines interlocking with each other. Nine years ago, while making some experiments with butter, I first observed that boiled butter exhibited small crystals somewhat stellar, but gave no further attention to the fact until May last. For the purpose of determining the real character of the crystals I procured a sample of pure dairy butter from Ohio. This was boiled, and when cold I examined it under a power of 75 diameters. To my surprise globular bodies were found, having apparently a very fine fibrous structure. When subjected to polarized light a cross consisting of arms of equal length was observed on each crystal. (See Figs. 2 and 3.) On ting the poles the cross of each crystal rotated. On rotating the g on which the specimen of butter was mounted the crosses remained tionary, thus showing that the appearance of the cross depends on the fact that the crystals are (1) globular, (2) polarizing bodies, (3) translucent, and (4) comparatively smooth. Were they opaque or non-polarizing, or did they consist of long spines causing great divergence of the rays of light, no image of the cross would be visible. But from whatever cause the appearance of the cross on butter crystals arises, its constant appearance on new butter under the conditions above described is a fact beyond any question, and, so far as my experience goes, the better the lity of the butter, the more clearly defined is the cross. It is black, ge, and well defined. When these crystals are under polarized light a selenite plate, they exhibit all the colors of the rainbow and are exceedingly interesting objects. (See Fig. 10.)

In order to leave no room for doubt respecting these crystals being liar to butter, I had cream churned, through the kindness of Mr. k K. Ward, of Washington, and a fine sample of granulated but- in my presence, a portion of which was secured; also a portion r from another lot made in my absence. The first lot was made

of pure Alderney cream, the second from *mixed cream.* The sa were kept apart in separate boxes, boiled, cooled slowly, and exa according to the methods described. Both samples gave the glo crystals, showing the cross. These crystals varied in diameter fifteen ten-thousandths to one one-hundredth of an inch. Very crystals, such as the latter, show the cross but dimly, while the ones show it distinctly. To this date I have received several of butter from Tennessee, Ohio, New York, Maryland, Virginia, an District of Columbia. All exhibited one or both forms of the cry common to butter, but generally the globular only. Pure mark store butter, which has been exposed to high temperature for se months, exhibits a greater number of the rosette forms, measuring about fifteen ten-thousandths of an inch. In general it may be that, as butter loses its freshness, either through age, heat, or causes, the globular crystals, with the cross which appears upon tend to give way to the rosette-like forms shown in Figs. 8 and 9, inferior butter appears to show the rosette-like forms much sooner that of the best quality. These latter forms appear to result fro breaking up of the globular crystals, in the center of which speck speck appears to expand into the rosette-like form and float (See Fig. 5.)

In examining the two butters received from Mr. Ward, I obser material difference in their appearance. Although all exhibite peculiar typical cross of St. Andrew, some brands exhibited glo crystals much more bright in color than others. The butter rec from Tennessee exhibited a peculiar indentation in the large cry and so well defined is this peculiarity that this brand may at once tinguished from all others I have yet examined. (See Fig. 6.) Se butters examined in May last, made from milk of cows fed on dry exhibited crystals more brilliant in appearance than those fed on in July. I think it probable that the butter crystals of different b may yet be distinguished from each other by some marked peculia although preserving always well-defined features common to butt

The globular crystals of some butters are exceedingly transpa in this case a very low power of the microscope should be used f aminations; an inch and a half objective serves the purpose.

Exceedingly small globular butter crystals may arise from one o causes, such as from the oily characters of the butter, or by coolin boiled butter too quickly. All boiled samples should be kept in a cool place to prevent the crystals from passing to the secondary characterized by the rosette-like forms. At high temperature, su 100° F., the globular crystals all dissolve. Should these precau be neglected effective crystallization will not take place and the will not be discovered.

MOUNTING BUTTER CRYSTALS.

A practical microscopist will readily perceive that from the very n the crystals great care must be exercised in mounting them. globular crystals should not be crushed; neither should they be ex to light except when necessary, or to a temperature of over 70° c At 95° I found the crystals of Tennessee butter dissolve whi Ward butter crystals at the same temperature retained very nearly [illegible]

[illegible] show their normal crystal [illegible] sweet [illegible]. When cold, the compo [illegible] butter should be

so liquid when cold that its crystals will swim incrusted on the surface of the oil. When a little of this floating incrustation is bruised gently in oil and mounted, beautiful discoid crystals will appear under the microscope. When normal crystals of fat of any description are mounted in oil it is difficult to preserve specimens of them for a long period, owing to their tendency to dissolve, especially at temperatures exceeding 80° F.

CHEMICAL TESTS FOR BUTTER, OLEOMARGARINE, AND BUTTERINE.

Oleomargarine made under the French patent, consisting mostly of beef fat, is easily detected by pouring a few drops of concentrated sulphuric acid on a portion about the size of a bean and mixing quickly with a glass rod. The mass at once assumes a light amber tint, soon turning darker and richer in color. After a period of from fifteen to thirty minutes it turns to a well-defined crimson scarlet. After a lapse of twenty-four hours it becomes the color of dark walnut.

Within the last six months I have failed to find any of this grade of butter substitute in Washington markets. It is giving way to various cheaper compounds, known as butterine.

True oleomargarine may be detected also by boiling a sample of it in an iron spoon, when the odor of burnt fat is given off. Butterine cannot be tested by this process satisfactorily, owing to the presence of butter in the mixture, the butyric acid of the butter being the most prominent odor observed.

If samples of pure butter, oleomargarine, and butterine are exposed to a temperature of 75° F., for a period of one hour, the last named will become slightly glossy, and at 85° will become almost semi-fluid, while the other two samples named will not appear to the naked eye to be thus affected and will preserve their sharp angles.

When oleomargarine or butterine is newly made, crystals of fat are seldom observed in it when viewed under the microscope; but in course of time, owing to their being subjected to light and increased rise of temperature in the stores, both exhibit crystals of fat more or less. In the butter substitutes of commerce, the crystals are seldom absent, but dark, nitrogenous, yellow, translucent bodies are always seen in them and are characteristic of them. These latter substances are never found in pure butter. When butter substitutes are sold as butter, they exhibit only the faint odor and taste of butter, and one is puzzled to know whether the article is genuine or not. In such cases it will generally be found to be either oleomargarine or butterine. When the suspected substance has a bad odor, and tastes like butter, it is probably old butter, provided it exhibits no dark yellow bodies when viewed under a power varying from 75 to 250 diameters.

HOW TO DETECT THE CRYSTALS OF LARD BY THE NAKED EYE.

Procure a piece of glass; place a small portion of the lard on it, cov-
it with a thick microscopic glass disk; press the parts together so
o form a thin film of the lard between, as described in the case of
View the glass and lard thus secured before a strong light,
white specks will be observed in the lard. The transparent por-
repr its the oil, the white specks the crystals of fat. In this
n y frequently be detected in oleomargarine and butterine.
: treated in this way exhibits a plain, even color. Mixed
re a streaky appearance, owing to their different densities

GENERAL NOTES.

Oleomargarine, when made under the formula of the French pat is composed mostly of beef fat churned with milk and colored with natto.

Butterine is said to be composed of the proportion of lard, 4 poun tallow, 4 pounds, and creamery butter, 2 pounds. A lower grad made as follows: Cotton-seed oil, 4 pounds; tallow, 4 pounds; grade of butter, 2 pounds.

It will be seen, from the two compositions of butterine above gi that the sulphuric-acid test would act differently in each case. I th fore advise the polariscopic test as the most effective for these con sitions.

EDIBLE MUSHROOMS OF THE UNITED STATES.

For several years past, the microscopic division of the Departme Agriculture has been in receipt of numerous letters from its reg correspondents and others, from which it appears that, in various lo ties representing almost every section and climate of the Union, tl are found large quantities of edible mushrooms and other allied fu few of which are, however, utilized, owing to the inability of the g majority of the people to distinguish the edible species from the poi ous ones. To obtain some clear and trustworthy criteria by whic make this essential distinction, has been the object of the various c munications received, and in view of the highly nutritious prope this class of esculents, and of the great possible value of their aggr product as indicated by the vast quantities produced in countr vi attention is given to their cultivation, the importance of a satis answer to these inquiries will be readily appreciated.

FOOD VALUE OF MUSHROOMS.

Rohllrausch and Siegel, who claim to have made exhaustive inv gations into the food values of mushrooms, state that "many sp deserve to be placed beside meat as sources of nitrogenous nutrime and their analysis, if correct, fully bears out the statement. They in 100 parts of dried *Morchella esculenta* 35.18 per cent. of protein *Helvella esculenta* 26.31 per cent. of protein, from 46 to 49 per cen potassium, salts, and phosphoric acid, 2.3 per cent. of fatty matter, a considerable quantity of sugar. The *Boletus edulis* they represe containing in 100 parts of the dried substance 22.82 per cent. of pro The nitrogenous values of different foods as compared with the m oom are stated as follows: Protein substance calculated for 100 p bread, 8.03; of oatmeal, 9.74; of barley-bread, 6.39; of legumi ruits, 27.05; of potatoes, 4.85; of mushrooms, 33.0. A much larger portion of the various kinds of mushrooms are edible than is gene supposed, but a prejudice has grown up concerning them in this c which will take some time to eradicate; nevertheless, they bute so considerable a portion of the food product of the world e may [illegible] their value will not be permanently overlooked, e all [illegible] consider our large accessions of population from c [illegible] the mushroom is a familiar and much-prized edible. [illegible] very large article of consumption [illegible] room beds cultivated in the caves [illegible] at Mary is mentioned as contai

21 miles of beds, and producing not less than 3,000 pounds in daily. Another at Frepillon contains 16 miles of beds. The bs and quarries of Paris and vicinity and the caves of Moulin che, Sous Bicetre, and Bagneux produce immense quantities of ms. They are all under Government supervision and are reg- ected like the mines.

shroom which is cultivated in these quarries and caves almost xclusion of all others is the "Snow Ball," *Agaricus arvensis.* ile is held in high esteem and is largely exported. In 1872 the of truffles exported from France was valued at over 3,000,000 nd in 1879 at nearly 10,000,000 francs. Immense quantities of *icus deliciosus* are sold in the Marseilles markets. The *Fistulina* is also in great demand, and many other varieties appear from time in the markets throughout France. The Chinese, who are r the care bestowed on their esculent vegetation, use large quan- the edible fungi, importing largely from Japan and Tahiti. The edible fungi from Tahiti to China commenced about the year 1868 only 70 tons were shipped, in 1873, 135 tons were ex- o China, and in 1874, 152 tons were exported.

alue of the mushrooms imported by Shanghai from Tahiti in s 107,000 taels, and in 1873, 138,800 taels—the tael is worth about ing. The fungus shipped, *Exidia auricula indæ*, is said to be h in fungine and nitrogen. It is a very bulky freight, 10 tons s much room as 30 tons of ordinary freight.

y laudable practice of the Chinese Government alluded to in an journal, and which might perhaps be advantageously adopted ountry, is the publishing for annual gratuitous distribution of s treatises describing the different herbs which can be utilized or in part for food purposes. One of these treatises is called ti-Famine Herbal," and consists of six volumes containing de- s, with illustrations, of over 400 plants which can be used as hese volumes are of inestimable value in districts where the of insects, drought, &c., have destroyed the grain and rice d famine is imminent. The Japanese grow several species of ungi in logs of decaying wood in a manner peculiar to them- and aside from the home consumption they in one year exported mushrooms to the value of $60,000. In 1879 mushrooms were l from Japan to the value of 243,440 yens—the yen is equal to ts. In Italy the value of the mushroom as an article of diet has understood and appreciated. Pliny, Galen, and Dioscorides various esculent species, notably varieties of the truffle, the and the puff-ball. At Rome it has been the custom of the Gov- to appoint inspectors to examine all the mushrooms brought market and to reject such as are poisonous or worthless, which wn into the Tiber. It was required also that no mushrooms e hawked about the streets, but that all should be sent to the ot for inspection.

ly average of the taxed mushrooms sold (all over 10 pounds ed) in the city of Rome alone, for the past decade, has been at between 60,000 and 80,000 pounds weight. Large quanti- shrooms are consumed in Germany, Hungary, Russia and in the latter country a list is published, by authority, of ooms which upon official examination may be sold. Darwin a del Fuego as the only country where cryptogamic plants article of food.

there eat no vegetable food except a bright yellow fun-

gus allied to *Bulgarin*. In England the common meadow mushroom, *Agaricus campestris*, is quite well known and used to a considerable extent among the people, but there is not that general knowledge and use of other species which obtains on the continent. Much has been done of late years by the Rev. M. J. Berkeley, Dr. Curtis, Dr. C. D. Badham, Dr. M. C. Cooke, Worthington G. Smith, Prof. Charles Peck, and others, to disseminate general knowledge on the subject. That America is no less rich in the quantity and variety of esculent fungi is readily seen by the fact that one hundred and eleven species of edible fungi have been descibed by Rev. Dr. Curtis, State botanist of North Carolina, as indigenous to that State alone, and late investigations show that nearly all the types common to the countries of continental Europe are found in different localities in the United States. Dr. J. J. Brown, of Sheboygan, Wisconsin, writes that edible mushrooms are found in his neighborhood in great abundance.

In preparing this paper for publication I have made selections from such specimens of edible fungi as have marked peculiarities in structure, habits, taste, odor, color, juice, and change of color of juice on exposure to the atmosphere.

ORANGE MILK MUSHROOM.

This agaric is highly recommended by different authors. It belong to the genus Lactarius, or the milk-bearing group. As a group, th milk fungi are the only ones which receive general commendation esculent. *Lactarius deliciosus* (Fig. 1 of Plate 2) is easily distinguish from any other of the group by the orange or red-colored milk it exude on being bruised or broken. The bruised parts turn, on exposure, to dull green color, as does the milk also on exposure to the atmospher This mushroom has a firm, juicy flesh, and the richly-colored top is co monly but not always marked with deeper-colored zones. The st often spotted with red; gills same color as the pileus. It is found fir plantations, pine, and swampy woods. It can be distinguished rea ily from another and a poisonous species, which is similar in shape a size, by its deeper color and by its orange-colored milk, the milk of t poisonous species being white and unchangeable. The flavor of the d liciosus, when cooked, is said to resemble that of kidney stew.

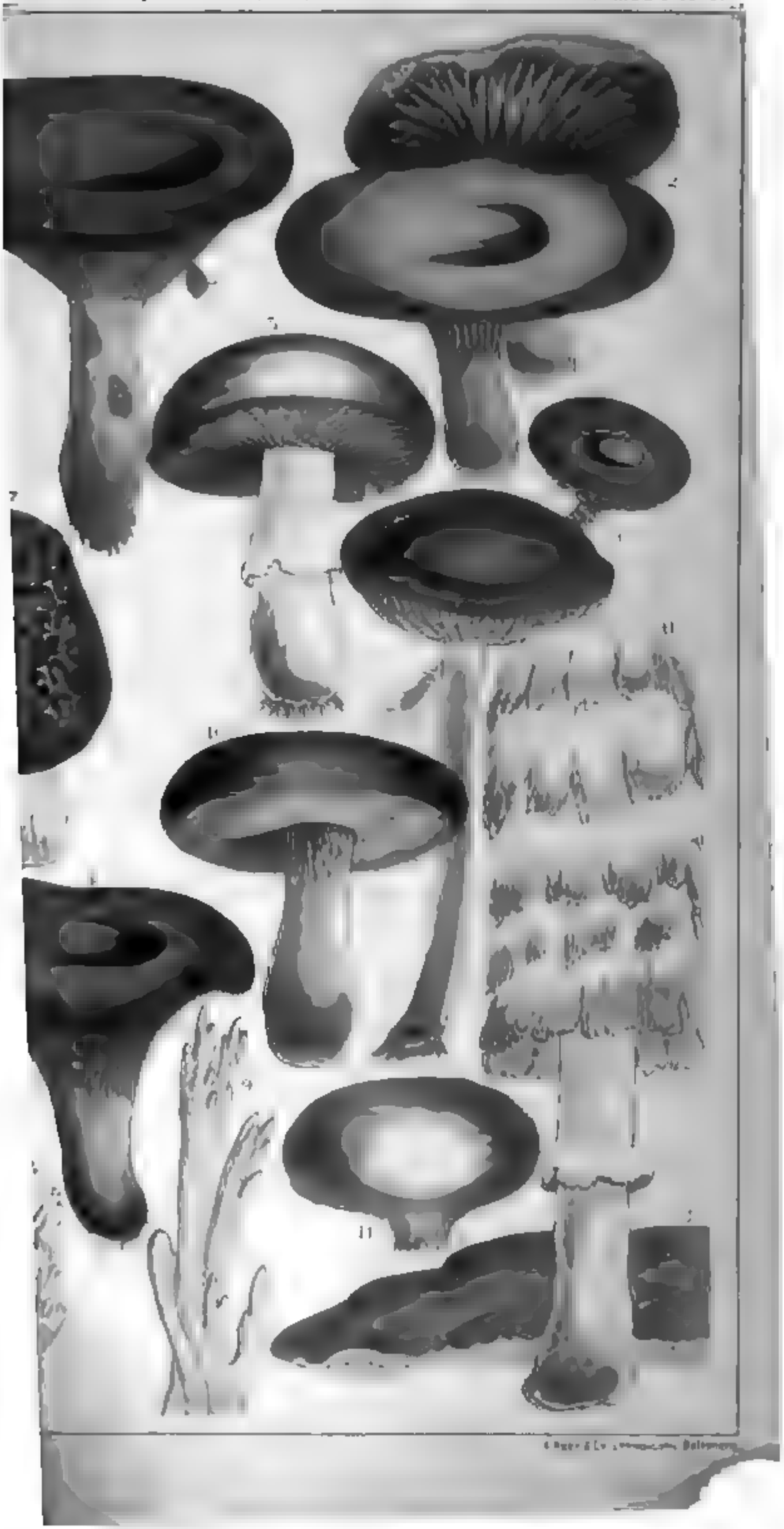
Mode of cooking.—"The rich gravy it produces is its chief characteristic, a hence it commends itself to make a rich gravy sauce, or as an ingredient in soups. requires delicate cooking, for, though fleshy, it becomes tough if kept on the fire un all the juice is exuded. Baking is perhaps the best process for this agaric to pa through."

CHANTARELLE.

Wherever found *Cantharellus cibarious* (Fig. 2) grows in great profusio It is very popular in Europe, where, in some localities, the inhabi make it their principal food. It is easily recognized by its rich c and the peculiar form of its gills. It is generally found in light wo and high situations. The pileus is lobed and irregular in shape. W young it is dome-like, the margin rolled in; as it approaches matu the margin expands, forming an irregular, wavy line, and is orange deep yellow, somewhat resembling that of the yelk of an egg. It youth the stalk is tough, white, and solid, becoming hollow in maturi The gills, which appear like short, branching veins, are thick and wi apart, and are of the same color as the pileus. The texture is smoo

EDIBLE MUSHROOMS COMMON TO THE UNITED STATES.

ICROSCOPIST, DEPARTMENT OF AGRICULTURE. PLATE II



te and dense and has a pleasant odor. Vittadina com- of plums. It is somewhat dry and tough in character, e requires slow and long stewing, with plenty of liquid. In for culinary purposes, crisp and heavy ones should be in preference to light and soft ones, being less likely to become y in cooking. Some recommend soaking them in milk over night them tender.

. Hussey gives the following receipt:

he mushrooms across and remove the stems, put them into a closely-covered sauce-pan with a little fresh butter and sweat them, take them out, wipe, and stew in gravy or fricassee until tender at the lowest possible temperature; a great heat always destroys the flavor.

A deleterious species of the cantharellus, *Cantherellus aurantiacus*, often found in rank grass or decaying herbage, is of the same color, and by a careless observer might be taken for the wholesome species. A little care and attention to detail, however, will enable one to distinguish one from the other. In the *Cantharellus aurantiacus* the gills are crowded, thin, and of a much deeper color than the pileus.

FAIRY RING CHAMPIGNON.

ius oreades (Fig. 3) is represented by all mycologists as one highly flavored. It grows in rings in short pastures on downs and by roadsides, but never in woods. It is very well marked, somewhat tough, the solid stem particularly so. In color it is a bright buff. The gills are wide apart and are of a cream color. When dried it can be kept for years without losing its flavor. "It is much used in the French "à la mode" beef shops in London, with the view of flavoring that dish." Badham, Rev. M. J. Berkeley, and Mr. Worthington G. Smith, of England, highly recommend the fairy ring champignon, and it is said by experts in the culinary art that when boiled with butter it has an exquisitely rich and delicious flavor. Mr. Berkeley says it is so common in some districts of England that bushels may be gathered in a day.

Another species of this genus, found growing in woods on dead leaves, to be avoided. The gills of this species are darker in color and narrower. It has a hairy down at the base of the stem, by which it may also be distinguished.

HEDGEHOG OR SPINE MUSHROOM.

genus, *Hydnum repandum* (Fig. 4), being so well defined, having instead of gills or pores, is easily distinguished from all others. pileus is irregular in shape, depressed in the center, fleshy, and cinnamon or yellowish in color.

firm and white, turning slightly brown when bruised. The are awl-shaped, of various sizes, crowded and running down, in color than the pileus. Stem solid, at first white and then tawny olor; spores round and white. There are no poisonous species genus, although some are too tough to be considered edible.

Hydnum repandum is the most desirable. M. Roques, an eminent mycologist, says:

neral use of this fungus throughout France, Italy, and Germany leaves no to its good qualities.

It is common in oak and pine woods in England. Mrs. Hussey rec ommends stewing this mushroom in brown or white sauce.

Cook slowly and for a long time, and keep well supplied with liquid, it being nat urally deficient in moisture.

Its dry nature makes it easy to preserve, and it may be kept for a great length of time.

MEADOW MUSHROOM.

To distinguish the common meadow mushroom, *Agaricus* (*psalliota campestris* (Fig. 5), requires very little discrimination. The cap or pil is fleshy, white, or tawny, sometimes brownish. When it is in its bes condition for use the gills are a beautiful pink in color; ultimately the become a deep brown, reaching nearly to the stem, which carries a well marked white woolly ring or volva. The cap is usually more or les adorned with minute silky fibrils. The margin generally extends a lit tle beyond the outer extremity of the gills. It has an enticing fragrance and the white flesh is sometimes inclined to change to pink when broken It grows in open grassy places, in fields and rich pastures, but never i thick woods.

It may be prepared for the table by stewing with butter, spice, pars ley, sweet herbs, salt, and pepper, and a little pure lemon juice. It make a fine catsup, and cut up in small pieces and stewed with butter make an agreeable adjunct to a steak or mutton-chop. The catsup may b used to give flavor to soup or beef tea.

This mushroom should be eaten fresh, and served hot.

Dr. Badham says:

The mushroom, having the same proximate principles as meat, requires, like meat to be cooked before these become changed.

Mr. Worthington G. Smith says:

The *Agaricus arvensis* (horse mushroom) is a species very nearly allied to the meadow mushroom, and frequently grows with it, but is coarser, and has not the same delicious flavor. It is usually much larger, often attaining enormous dimensions; it turns a brownish yellow as soon as broken or bruised. The top in good specimens is smooth and snowy white; the gills are not the pure pink of the meadow mushroom, but a dirty brownish white, ultimately becoming brown. It has a big, ragged floccose ring, and the pithy stem is inclined to be hollow.

MANED AGARIC.

The maned agaric, *Coprinus comatus* (Fig. 6), is considered one of the most delicious of all the mushroom tribe when in its young condition. The cap is at first cylindrical, ultimately bell-shaped. It is expanded more or less scaly, and soon splits longitudinally. The epidermis is thin; flesh thick in the center and very thin at the margins. The gills are free, and at first white or pinkish, then black, soon melting into an inky fluid, whose black color is due to the black spores with which it is filled. The ring on the stem is movable, then disappearing. The stem is white and hollow. This fungus grows in waste and grassy places, lawns, and meadows. Only young specimens are desirable for esculent purposes. Mr. Worthington G. Smith [illegible] the result of considerable experience [illegible].

[illegible] young this agaric is rather deficient [illegible] ers tenacious [illegible] its flavor is most rich and its texture most delicate [illegible] the pink color with sepia margins.

[illegible] dry, [illegible] uld be cooked immediately after [illegible] [illegible] [illegible] ve on toast.

MORCHELLA ESCULENTA.

lla esculenta (Fig. 7) is known under a variety of names—*Phal-ntus*, *Helvella esculenta*, &c. The genus *Morchella* has but few nd most authors agree that all are edible. Berkeley considers *hella semilibera* as doubtful. The head of the morel is deeply ollow, thin, and firm, and when fully grown is several inches in . The morel is found in April or May in grassy places on the fields and the raised banks of streams, sometimes in fir or forests and in hilly countries. It prefers a calcareous ground ishes on wood ashes.

many, France, and England it is well known and highly es- In the United States it is little known, although it grows in f the States in great abundance. I have had specimens of it ssouri and Wisconsin and from Maryland. Curtis speaks of t in North Carolina, but not in quantity. It is identical with pean morel. In Yorkshire, England, the women who gather for wine brewing bring to market a few morels in the corner of skets and ask an extra shilling for them. The dried morel is parts of England to give flavor to certain kinds of sauce. Large s of this fungus in a prepared condition are imported into Eng- n the continent.

llowing receipts will illustrate some of the methods of cooking llent mushroom:

washed and cleansed from them the earth which is apt to collect in the hol- plants, dry them thoroughly in a napkin and put in a sauce-pan with pep- nd parsley, adding or not a piece of ham; stew for an hour, pouring in ly a little broth to prevent burning. When sufficiently done, bind with the ro or three eggs and serve on buttered toast.

CLAVARIA CINEREA.

ecies (Fig. 8), M. C. Cooke observes:

short thick stem, is very much branched and irregular, and becomes ulti- cinerous hue. The substance is brittle and not tough, as in some species. it is known under various names, as *Pied de coq*, *Gallinole*, &c., and in Italy *ssa*; in both of those countries it is eaten.

uite plentiful in this country. I have had some fine specimens White Mountains. All the white-spored claverias are whole-

CLAVARIA RUGOSA.

ecies, *Clavaria rugosa* (Fig. 9), is not generally found in suffi- ntities to make it of much value as an esculent, but it is whole- l can be cooked with other varieties of the *Clavaria*. It is in shape, white, and sometimes delicately tinted with gray. oking the *Clavaria* should be sweated with butter over a slow the liquor thrown away. The *Clavaria* should then be wrapped of bacon and stewed for an hour in a little sauce or gravy sea- salt, pepper, and parsley, then served with white sauce.

EDIBLE PORE MUSHROOM.

's of the *Boletus edulis* (Fig. 10):

which has at different times and under different mycologists at in turn many different funguses, is now restricted to such as

have a soft flesh, vertical tubes underneath, round or angular, slightly connected together and with the substance of the cap, open below and lined by the sporiferous membrane; the cap horizontal, very fleshy; the stalk generally reticulate.

In this group there are but few edible species and some very deleterious. The flesh of the poisonous species invariably turns blue when bruised or broken. That of the edible species does not turn blue. This is an important general distinction, which will save much inconvenience, at least, if kept in mind. "The *Boletus edulis*," says Badham, "cannot be mistaken for any other boletus because it alone presents all the following characters united, viz: A cap, the surface of which is smooth; tubes, the color of which varies with each period of its growth; beautiful and singular reticulation of the stalk, especially towards the upper portion, and a flesh which is white and unchanging."

The cup is brown. At first the tubes are white, then pale yellow and when mature a dull, greenish yellow. For table use the should be gathered when tubes are pale yellow; it is then [illegible] The stem is solid and quite thick, at first white, but turning to light brown in maturity, displaying near the top a network of pinkish veins It is sold in quantities in Italy. It is also quite popular in Hungary, Germany, Russia, and other European countries. It grows abundantly in the autumn, although often found in spring and summer. It is found chiefly in woods, more especially in those of pine, and chestnut. The following receipt for cooking the boletus is given by Persoon:

It may be cooked in white sauce, with or without chicken in fricassee, broiled baked with butter, salad-oil, pepper, salt, chopped herbs, and bread crumbs, to which add some ham or a mince of anchovy.

Its flesh is tender and juicy, and its requires less cooking than some of the tougher mushrooms.

PUFF-BALL.

The giant puff-ball, *Lycoperdon giganteum* (Fig. 11), so generally neglected, is one of the most valuable of edible fungi. It is readily distinguished from other puff-balls and allied fungi by its large size, it being from 10 to 20 inches in diameter, and by its structure is separated from all other large fungous growths. It is somewhat globular in form, whitish, or pale yellowish brown in color, filled with a soft white flesh when immature, which changes to an elastic yellowish brown cottony but dusty mass of filaments and spores when mature.

In this state the peel or rind breaks up and gradually falls away in fragments. I have made full inquiry regarding it among connoisseurs and have not found a dissenting voice as to its value as an esculent. All mycologists are agreed as to its edibility and tender character. A number species are edible, but the smooth-skinned varieties are more palatable than the rough-skinned.

Vittadini, an Italian mycologist, says:

When one giant puff-ball is conveniently situated you should only take one slice at a time, cutting it horizontally and using great care not to disturb its growth, to prepare a [illegible] fritter every day for a week.

[illegible], an eminent London mycologist, writes with enthusiasm of the merits of the giant puff-ball as an esculent, deeming it delightful breakfast relish

Mrs. Hussey, of England, gives the following receipt for puff-ball omelette:

First remove the outer skin; cut in slices half an inch thick, have ready some chopped herbs, pepper, and salt; dip the slices in yelk of egg, and sprinkle the herbs upon them; fry in fresh butter, and eat immediately.

The puff-balls must be gathered young. If the substance within is white and pulpy it is in good condition for dressing, but if marked with yellow stains it should be rejected.

The puff-ball is found growing in profusion in many parts of the United States, and a few fine specimens have been forwarded to the Department for inspection. I have myself tested a fine specimen of the giant puff-ball, found in the Department grounds, finding it when fried in egg-batter very delicious eating.

J. M. Dodge, of Glencoe, Dodge County, Nebraska, writes to the Department under date of April 9, 1878:

I am much interested in the article, "Edible Fungi," published in the Department report for 1876. We have here a species of puff-ball which when young has firm white flesh, and I think would be good to eat. It sometimes grows to a large size. It is usually quite abundant on the prairies in summer, and, if edible, would offer a large amount of food.

I am informed that the giant puff-ball, *Lycoperdon giganteum*, is found in great abundance growing on the Genesee flats, Livingston County, New York.

LIVER FUNGUS.

T ungus, *Fistulina hepatica* (Fig. 12), is frequently found on old , chestnuts, and ash. It develops from the rotten bark. It appears as a rosy pimple at any time during the summer season. In a very time it becomes tongue-shaped, and assumes the color of a beet- In a few days it changes form again, becoming broad in compar- to its length and changing in color to a deep blood red. Its lower s often paler than its upper, it being tinged with yellow and u It requires about two weeks to attain its highest develop- ater which it gradually decays.

It varies in size from a few inches to several feet in circumference. M. J. Berkeley mentions one which weighed 30 pounds. It has led the "poor man's fungus," and in flavor resembles meat more any other.

en young and tender it can be sliced and broiled or minced and ed, making a delicious dish. When old the stock is rather tough good eating, but the gravy taken from it is equal to that of the best . The following receipt for cooking this fungus is recom- : S e and macerate it, add pepper and salt, a little lemon, and alots, a species of onion or garlic; then strain and boil the w n makes most excellent beef gravy.

This fungus is esteemed in Europe, where it is eaten prepared in a variety of ways. Where it grows at all, it grows abundantly. I have found some fine specimens in the District of Columbia.

METHODS OF CULTIVATION.

y methods of cultivating the common meadow mushroom have p ted by different growers, but all agree as to the value of d in practice. Nearly every farm and nursery affords cessary to cultivate the ordinary field mushrooms; ntered sheds, stables, and small hot-beds for winter cultiva- melon patches, cucumber pits, &c., for summer culture.

Mushroom spawn in "bricks" can be easily obtained from the seeds men. Natural or virgin spawn, which is considered by many experienced growers as preferable to the artificial, can be obtained in most places where horses are kept. It is found in half decomposed manure heaps, generally where horse-droppings have accumulated under cover. It is easily distinguished by its white filamentous character and by its mushroom odor. When dried it can be kept for years.

Mushroom beds are easily formed on the floor of sheds by carrying in the fresh stable dung, adding to it about one-fourth of good loam, mixing both together, pressing firmly down, and letting the mass remain about two weeks untouched. By this time the temperature will be on the decline, and when it falls anywhere between 50° and 60° F. break the spawn bricks into pieces 2 inches square and plant 12 inches apart, 3 inches below the surface. By means of any suitable instrument beat the mass down firmly, then add 3 inches of good soil and beat again.

Mushrooms generally take six weeks to fit them for eating purposes. When ready they should be carefully cut off with a knife, not broken.

Robinson, author of an instructive work on mushroom culture, recommends that the bed should not be finally earthed until the spawn is seen beginning to spread its white filaments through the mass; and should it fail to do this in eight or ten days after spawning, the conditions being favorable, it is better to insert fresh spawn or to remake the bed, adding fresh materials if it be found to fail from being too cold. The temperature of the beds at spawning time should not exceed 80° F.; 70° is considered the most suitable regular temperature.

With regard to the depth at which spawn should be placed, Mr. Robinson says: "It would be better not to put it at any uniform depth, but so that while one piece of it may be at a depth of 6 inches or nearly so others may touch the surface. This would allow of the spawn vegetating at a depth and temperature most congenial to it."

Mushrooms may be cultivated in warm cellars, in boxes about 4 feet square by 18 inches in depth, for family use.

THOMAS TAYLOR, M. D.,
Microscopist.

Hon. NORMAN J. COLMAN,
Commissioner.

REPORT OF THE CHEMIST.

I have the honor to submit herewith a report on the operations division during the past year.

is report will be found a résumé of the principal work carried on division, divested of such merely technical information as might to the professional chemist but not to the agriculturist.

e ceding year a considerable amount of work was done by the in the analysis of dairy products, having for its object the de- tion of a standard of good milk and butter and the detection of ent of the adulteration which these substances are subjected to.

ped that this work might be continued during the year which passed, but the magnitude of the work required by the experi- n the manufacture of sugar rendered this plan impossible. Nev- s the importance of the study of food adulterations in general to be of so great importance that it has been continued by an ration of honey and its adulterations. It is the purpose of the in accordance with your suggestions, to extend such investi- so as to include all the more important varieties of food.

HONEY AND ITS ADULTERATIONS.

honey is the nectar of flowers passed through the organism of and stored in a comb. Adulterated honey is any compound or tion known or sold as honey, which has not been formed in the described. Chemically considered, therefore, pure honey con- the substances gathered by the bee from flowers, subjected to odifications as they may undergo in the insect laboratory through hey pass.

saccharine exudation of flowers consists of a mixture of various containing in the form of pollen a small quantity of nitrogenous

The exact number and kind of sugars in the nectar of flowers er been determined. Wilson * estimated the reducing sugar and in the nectar of certain flowers. All the sugars, however, reduc- per, were classed as glucose. In general, the total quantities of gars were greater than the sucrose present. In the flower of the er the glucose was three times as much as the sucrose. Since honeys there is very little sucrose, it follows that the chief change nectar undergoes before it appears as honey is in the inver- crose.

the last year several samples of honey have been examined, which were known to be genuine and others of unknown origin.

* Chemical News, vol. 38, p. 93.

Following is a description of the various samples examined:

No. of sample.	Description.	Pri po
		0
1	Choice goldenrod honey, from William Thompson, Wayne County, N. Y	
2	Choice comb honey, from Githuns & Rexamer, Philadelphia, Pa	
3	.....do	
4	.....do	
5	Strained honey, marked C. O., Perrine, Indiana	
6	A very dark honey, exhibited at Indiana Bee Keepers' Association	....
7	Choice clover honey, from Charles Israel, New York	
8	Pure white clover honey, marked G. R. X. X., Pennsylvania	
9	Honey in comb, locality not given	
10	California comb honey, bought in Lafayette, Ind	
11	Strained honey, marked C. O., Perrine, Indiana	
12	Eagle brand honey (in comb), Cayuga County, N. Y., bought in open market, Lafayette, Ind.	
13	White clover honey, from C. W. Hutchinson, Acton, Marion County, Ind	....
14	Sample from Louisiana, C. F. Muth, Cincinnati, Ohio	....
15	Basswood or linn honey, from Illinois, C. F. Muth, Cincinnati, Ohio	....
16	Mangrove honey, from Florida, C. F. Muth, Cincinnati, Ohio	....
17	.....do	....
18	Pure white clover honey, apiary, M. B. Shaw, 378 Union street, Indianapolis, Ind	
19	Strained honey, from choice selected white clover	
20	Pure extracted honey (crystallized), from R. F. Weir, South River, Md	
21	Pure extracted honey (liquid), from R. F. Weir, South River, Md	
22	No brand—from J. Hepsburger, Maryland	
23	Comb honey, made in Tippecanoe County, Ind	
24	Strained honey, bought in bulk	
25	Comb honey, bought in open market, Indianapolis, Ind., from H. K. Thurber, New York.	
26	Pure machine extracted honey, Italian Apiary, F. W. Abbot, Indianapolis, Ind	
27	Sample marked B. F. Davis, North Salem, Hendricks County, Ind	....
28	White clover and bass-wood honey (comb), Linden Place Apiary, Indianapolis, Ind., Pugh & Dougherty.	....
29	Choice extracted honey—strictly pure, from McCone & Hildreth, New York	
30	No brand—from Charles S. Duval, Spencerville, Md	
31	Comb honey, made in Tippecanoe County, Ind	
32	Comb honey, from Chicago, Ill	
33	Comb honey, made in California	
34	Strained honey, marked white clover, XX C and R	
35	Comb honey, bought in open market, Indianapolis, Ind	
36	Pure extracted honey, from F. S. Bull & Sons, Valparaiso, Ind	...
37	Pure extracted honey, from Dougherty & McKee, Indianapolis, Ind	...
38	Extracted honey (dark), supposed to be from sunflowers	...
39	Sample, donated by C. F. Muth, Cincinnati, Ohio	...
40	Clover honey, donated by C. F. Muth, Cincinnati, Ohio	...
41	White sage honey, from J. E. Pleasants, Santa Anna, Los Angeles County, Cal	...
42	Sumac honey, from J. E. Pleasants, Santa Anna, Los Angeles County, Cal	...
43	Clover honey, from near Cincinnati, C. F. Muth, Cincinnati, Ohio	...

For convenience of study the analyses of the above sampl ranged in five groups.

In Table No. 1 are collected the analyses of those samples which dulterated with starch sirup.

In Table No. 2 are found those samples which apparently were erated with sucrose.

In Table No. 3 are grouped those samples to which it appears tha rt sugar may have been added.

n Table No. 4 are found the analyses of those samples which ap be genuine.

able No. 5 are collected the analyses of those specimens obtained from producers dealers, and which I have every o believe are genuine.

TABLE I.—*Honeys adulterated with starch-sirup.*

Water.	Ash.	Albuminoids.	Reducing sugar.	Polarizations. Direct.	Temperature, C°.	Invert.	Temperature, C°.	Sucrose by polarization.	Reducing sugar after inversion.	Sucrose by reduction.	Total solids.	Solids not determined.	Reducing sugar before inversion to total solids.
Pr. ct.	Pr. ct.	Pr. ct.	Pr. ct.					Pr. ct.	Pr. ct.	Pr. ct.	Pr. ct.	Pr. ct.	Pr. ct.
19.79	.36	26	60.18	52.25	30.5	.. ..	.. ..	3.99	61.33	1.09	80.21	15.42	75.03
18.99	.21	.07	57.40	74.50	21.5	.....	.....	... .	59.85	2.37	83.07	25.39	69.09
.....	..	.....	51.90	74.00	24.5	73.80	24.0	.....	.....	.....	.....	.....	.....
.....	.....	.....	60.91	9.50	25.0	.. ..	.....	.....	.....	.....	.....	.....	.....
22.45	.31	.26	40.00	89.50	21.5	67.50	21.6	16.50	57.00	16.15	77.55	20.50	51.56
13.41	1.27	.35	57.80	24.65	28.0	16.60	22.6	5.64	64.25	6.45	84.59	19.53	68.09
19.07	0.18	.....	65.23	26.88	25.5	23.50	25.0	.....	64.85	.....	89.93	15.52	60.60
18.73	.47	.18	56.19	.....	.....	.....	.....	6.58	61.48	5.20	79.27	19.27	70.06

TABLE II.—*Honeys apparently adulterated with sucrose.*

20.90	.16	.18	56.85	1.30	25.0	—16.50	24.0	13.49	74.07	14.48	76.10	5.62	77.53
16.69	.13	.18	69.04	—2.75	26.5	—13.20	26.5	7.87	75.36	8.28	85.91	6.60	71.68
15.61	.04	.23	60.75	—7.50	23.5	—20.50	23.0	9.81	80.25	19.47	84.99	5.15	83.01
22.45	.31	.24	40.00	89.50	21.5	67.50	21.6	16.50	57.30	16.15	77.55	20.50	51.56
19.46	.16	.21	[illegible]	.....	.....	.....	.....	11.79	71.65	14.56	80.64	8.82	70.49

TABLE III.—*Honeys apparently adulterated with inverted sucrose.*

15.13	.23	.36	75.85	—15.50	21.5	—17.70	21.6	1.65	77.20	1.28	84.66	8.59	89.90
17.34	06	24	75.50	—17.20	25.5	—19.80	26.0	1.98	77.10	1.52	83.76	5.60	91.23
23.25	40	.31	73.50	—15.00	15.0	—17.40	25.4	1.82	71.60	..	76.75	73	95.77
19.46	14	.35	73.05	—15.35	25.0	—18.40	26.0	2.40	78.42	5.10	80.54	4.60	90.70
20.53	13	28	75.02	—19.15	25.0	—21 00	25.4	1.41	77 42	2.28	79.42	2.65	94.38
21.08	.13	28	73.80	—18.85	25.5	—20.70	25.2	1.56	74.10	.76	78.87	2.70	93.82
18.25	06	28	73.80	—17 25	22.5	—19.70	23.0	1.77	77.10	3.78	81.75	5.84	90.28
19.42	08	21	69.90	—19.70	21 5	—23.60	23.0	2.96	78.50	3.42	80.58	7.46	86.75
22.76	.06	.16	72.12	—14.50	26.0	—16.00	26.0	1.14	73.58	1.88	77 24	3.76	93.87
19.35	04	09	73.78	—13.00	25.0	—17 00	25.0	3.08	74.59	.77	80.65	2.71	91.48
17 77	.10	24	74.75	—14.25	24.5	—14.50	25.0	20	76.77	.97	82.23	6.84	90.80
15.82	11	53	73.75	-14.55	21.5	-17.10	22.5	1.92	75.10	1 28	81.18	4.87	90.97
20.74	08	70	67 55	—14.40	21 5	16.10	22.0	1.27	67 00	.....	79.26	9.66	85.23
16.69	08	85	75 00	-15.55	22 5	-18.70	22.6	2.37	77 00	1.90	83.33	5.52	90.61
16.15	05	85	76.05	--14 10	22.5	16.10	23.0	1 51	76.25	.19	83.85	5.69	90.70
15.91	14	.42	74.75	14.95	25.5	—16.40	27 4	1.11	77 00	2.18	84 09	7 67	88.69
17 92	05	.35	76.46	—14.40	22.5	— 17.10	22.5	2.03	74.80	.....	82.08	4.20	91.82
18.86	.11	34	73.71	—15.75	.....	—18.10	.....	1.77	75.16	1.84	83.15	5.22	90.37

TABLE IV.—*Honeys bought in open market which appear to be genuine.*

20.80	16	.18	69.48	— 2.50	25.0	— 3.50	24.0	.76	71.79	2.17	79.19	8.52	87.93
17.84	41	.26	68.55	— 1.85	25.0	— 4.26	25.6	1.75	73.14	4.37	82.16	11.19	83.43
19.85	.13	59	72.00	-12.55	23.5	—15.20	23.6	2.00	71.80	.....	80.15	5.33	89.83
17.08	14	53	78.85	—11.25	23.0	—14.00	23.0	2.07	73.88	.....	82.92	6.33	89.06
16.64	07	.17	70.35	— 9.40	21.5	—18.50	22.0	6.84	75.75	5.13	83.36	5.93	84.39
17.79	22	39	68.80	— 6.55	21.5	—12.20	22.0	4.24	71.40	2.47	82.21	8.56	83.69
16.38	25	26	74.45	— 8.05	23.5	—10.10	23.0	1 55	75.70	1.19	83.62	7.09	89.03
18.00	20	34	71.09	- 7 40	.....	—11 11	....	2.74	73.32	2.19	81 93	7 56	86.77

TABLE V.—*Honeys furnished by producers and dealers, apparently genuine.*

14.97	.14	24	74.70	—11 55	22.5	- 14.10	23.0	1.92	76.60	1.81	85.03	8.03	87.85
22.75	.83	21	68 75	—12. 15	22.5	13 70	23.0	1.17	71.00	1.16	78.25	7.09	88.83
18.75	27	39	69.65	— 5.40	25.5	- 8.00	25.6	1 96	73.25	3.42	81 25	8.96	85.72
21.32	.77	.59	66.10	—10.50	25.5	12.00	27 0	1 15	69.05	2.70	78.68	10.07	84.01
18.35	08	71	72.50	11.85	25.5	13.80	25.2	1.62	74.35	1 78	81 65	7.14	88.79
14.62	05	21	71.25	—11.50	25.5	-20.50	26.5	6.88	75.35	3.90	85.38	6.96	83.45
14.22	06	24	71 16	—12.10	25.5	-20.00	26.5	6.04	73.85	2.61	85.67	8.23	82.99
16.69	.07	.31	73.59	—12.85	25.0	- 15.70	25.4	2.17	74.55	1.02	80.40	4.35	91.47
17.93	.18	.31	71.07	—10.90	.....	- 14.70	.....	2.87	73.50	2.39	82.04	7.60	86.04

REMARKS ON TABLES.

The temperature at which the direct polarization is taken is given, s that if any great difference in the two temperatures should occur it be at once noted. Since the temperature has a marked influence on lævo-rotatory power of invert sugar it should always be taken into ac count in expressing the data of the work. In order to secure r which are strictly comparable, some definite degree of temperature be chosen at which all the polarizations should be made or to which should be reduced. I am now having an instrument constructed whic will enable me to make all such polarizations at any selected tempera ture.

The percentage of reducing sugar is calculated for dextrose, and th numbers, therefore, must be taken with this understanding. In the l column of each table are found the percentages of such sugars in of total solids. This gives a much better idea of their relative amoun than if they were expressed in percentages of the weight of the sul stances examined.

In the polarizations the numbers given are divisions of the cane su scale of a large Laurent shadow polariscope in which 16.2 grams of sugar in a volume of 100 cubic centimeters will produce a right-h e rotation of 100. The sucrose was calculated from the two pola copi readings (before and after inversion) by the usual formula.

Table No. I.—In all these samples, as indicated by the analyses, starc sirup (glucose) was largely used as an adulterant.

In No. V very little real honey could have been present. The s was composed almost exclusively of starch-sirup and of sucrose, w had been added to give it sweetness.

In the other cases the sucrose which was found by analysis was d less originally present in the honey part of the mixture, since, been added as an adulterant more of it would have been found. characteristics of each sample, as well as of all of them collectively, be seen by studying the table.

Table No. II.—The mean percentage of sucrose present in these sam ples, as determined by double polarization, is 11.79, and by reductio 14.58, with the exception of No. II, to which sucrose was undoubtedl added. I cannot think that any sucrose was added by producer dealer, on account of the small percentage of it found. In such it is proper to suppose that the bees had access to flowers whose n was rich in sucrose, or that had been fed a solution of that substanc The use of solutions of sucrose as bee food is not unusual.

Table No. III.—These sixteen samples are grouped together on a count of their great lævo-rotatory power. For the first polarization th amounts to 16.75 divisions and for the inverted liquids to 18.10. It possible that this great deviation to the left may have been due to t entire absence of dextrine or sucrose in the honeys, or that it might ha been produced by the bee food being rich in sucrose, which suffered nearly complete inversion in the body of the insect.

t would be quite improper to definitely assert that invert sugar-sir d been added as ntended adulterant. I think it quite possi access to sucrose food might at one time produce Table No. II and at another like that in Table No. I these honeys all appear to be genuine, although it en such samples as Nos. 31 and 32, and tho he mean reading to the left is 7.40 divisio afterwards The mean of undetermin

7.56, and the percentage of reducing sugar before inversion to nds 86.77; the means of sucrose as determined by both methods r and fairly agree, although as in the other tables they differ in single instances.

No. V.—These honeys, obtained directly or indirectly from well-apiarists, I have every reason to believe to be pure. If they any adulteration it has been added by artificial feeding and not nally. It will be observed that these honeys are strongly lævo-, and indeed so much so that some of them might have appeared e No. III.

ll be instructive to compare the numbers in the above tables with btained by other analysts. Koenig* gives the following mean een analyses:

	Per cent.
Water	19.61
Albuminoids	1.20
Grape-sugar	70.96
Sucrose	2.76
Pollen	.17
Ash	.19
Phosphoric acid	.03

ehner † gives the following numbers as the mean of twenty-five

	Per cent.
Glucose	67.2
Water	19.2
Not determined	13.5

rding to Hehner, the fluidity of the honey does not depend on ount of honey it contains. In ten cases the quantity of glucose version was less than before, in one instance 5.23 per cent. less. ating power was generally zero, a condition which I have never n American honeys, genuine or artificial. These conclusions are riance with ordinary experience as to indicate that the samples d were anomalous or the methods employed unreliable.

n‡ gives the mean composition of sixty samples of honey as :

	Per cent.
Dextrose	34.71
Lævulose	39.24
Sucrose	1 80
Water	19.98
Non-sugars	5.02

ls not determined, as will be seen by the analyses presented t, are of considerable importance. In adulterations with sirup these undetermined solids consist chiefly of maltose

ttel, p. 161.

— .ol. 9, pp. 64 *et seq.*

l. Ver. f. d. Ruebenzucker-Industrie, vol. 34, pp. 837 *et seq.*

–'85

and dextrine. In many other cases dextrine, as will be shown fi
on, is doubtless present.

Genuine honey has also a slightly acid reaction. This acidity
either to certain organic acids derived from the plants or more
to an acid furnished by the bee itself. The kind and quantity or
honey have not been accurately studied. I have found the total a
measured as formic acid to be about .02 per cent. That the aci
nished by the bee is formic there is little doubt. Will* states tl
has found the active principle of the poison of all hymenop
formic acid. Carlet,† in a communication to the French Acad
that the poison of all the hymenoptera has an acid reaction,
contains also an active alkaline substance. The activity of t
is conditioned on the presence of both the acid and alkali. The
always in large excess and each substance is furnished by a s
gland. The inversion of the cane-sugar in the organism of the be
be due to the presence of these acids. On the other hand, it is plai
certain species of pine and some other plants furnish formic aci
therefore the detection of this acid in honey is not positive evi
that it is derived from the bee. In a recent article‡ the author
that the formic acid which honey contains tends to preserve it fro
mentation. Honey sirup, from which the greater part of the
acid has been washed out or expelled by heat, does not keep as
the normal product. The latest researches show that this acid
posited by the bees themselves by means of their stings. From
to time the bees apply to the walls of the cells of the comb th
drops of poison (formic acid) that gather on the ends of their
Sooner or later this remarkable antiseptic is incorporated wit
honey. The preservative power of this acid is said to be greate
than that of phenol.§

A careful study of the results of these analyses shows the chief
terants of honey are the following:

COMMERCIAL GLUCOSE.

This substance, on account of its honey-like appearance and low
has been one of the most common substitutes for honey. Mixe
enough of the genuine article to give it a flavor, it is sold extensiv
pure extracted honey. A very frequent method of adulteratio
take a few ounces of genuine comb-honey, place in a can holding
pounds, and then fill up with glucose. The real honey will gra
diffuse throughout the whole mass, giving the required flavor.

This, the most frequent sophistication of honey, is also the
readily detected. The high dextro-rotatory power of commerci
cose renders its detection by optical methods extremely easy. Co
ing as it does a considerable percentage of dextrine and malt
percentage of reducing sugar is consequently small. In ten sa
purchased at random in the Eastern markets three were adulte
this way. In eleven samples purchased in the Western market on
was glucose. This percentage, however, does not represent the
amount of the adulteration. In making these purchases I endeavo
get a sample of each kind of honey on sale. It will be found th
strained honeys of commerce are quite generally adulterated wit

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*Leiden and Foreps, Not., Sept., 1848, p. 17.
†Comptes Rendus, June 23, 1884, p. 1550.
‡Deutsch Americanische Apotheker-Zeit., 5, 21, p. 664.
§Comptes Rendus, vol. lxi, p. 1179.

DETECTION OF ADULTERATION WITH GLUCOSE.

I have never yet found a genuine honey which was not lævo-rotatory. Nevertheless the turning of the polarized plane to the right is not conclusive evidence of the presence of glucose unless the amount of deflection is more than 100° of the cane-sugar scale when the amount of the substance taken for examination is the same in weight as that required by pure sucrose to read 100 divisions.

After treatment with .1 volume of hydrochloric acid and heating to 70° C. the solution is cooled and repolarized. If now it still reads to the right the presence of starch sirup is established. In such cases, after inversion, the free acid is neutralized and the reducing sugar determined by an alkaline copper solution. The percentage of this sugar will fall much below 70, unless a large part of the adulteration has been due to cane-sugar.

CANE-SUGAR (SUCROSE).

A thick sirup made of cane-sugar is also used to adulterate honey. There is only one reason why it is not more extensively employed, viz, its tendency to crystallize. On this account it can only be used in small quantities. There would be no difficulty in detecting added cane-sugar in honey were it not for the fact that we cannot definitely say how much of this substance is present in the genuine article. In the analysis given by Seiben,* the mean of sucrose in the sixty samples was 1.08 per cent.; in one case, however, it amounted to 8 per cent. In the analyses given in this paper the mean percentage of sucrose in eight samples of genuine honey was 2.87, and in seven samples which appear to be genuine 2.74, and in the samples contained in Table No. III, sixteen in number, which may be genuine, 1.77 per cent. Judging from these analyses I would say that it is a rare thing to find a genuine honey which contains more than 4 per cent. sucrose. In the two samples of California honey, Nos. 41 and 42, the percentage of sucrose is very high. Doubtless the kind of flower and climate have much to do with this, and it would not be strange if California honey, produced in the unique conditions of climate and flora which there obtain, should develop some constant difference from honeys produced in other parts of the world.

DETECTION OF CANE-SUGAR IN HONEY.

The presence of cane-sugar in honey is easily detected by the process of double polarization. Illustration: Sample No. 14; weight of sample taken, 16.2 grams in 100 cubic centimeters; length of observation tube, 400 millimeters; reading of scale, —15; divide this number by 2 gives, —7.5 divisions, correct reading for a 200-millimeter tube. After inversion the reading in a 220-millimeter tube was —20.5 divisions; temperature, 23°; difference of the two readings, 13 divided by 144 —11.5 equals 9.31 per cent., equals sucrose present.

The method of double reduction of Fehling's solution once before and once after the inversion of the cane-sugar can also be employed. The optical method is quicker, and when properly conducted more reliable than the method by reduction. If the rotatory power of the sample is quite small, two or three times the normal quantity may be taken, and the polarization conducted in a 400 or 500 millimeter tube.

INVERTED CANE-SUGAR.

As [illegible]t of honey the inverted cane-sugar is much superior [illegible]lf. It does not crystallize, and when properly made

* Op. cit.

is palatable and wholesome. Sucrose is usually inverted by heating with an acid, and for commercial purposes sulphuric acid is the one generally employed. The difficulty of removing all traces of this acid renders the detection of inverted sugar somewhat easy by the presence of the traces of the sulphuric acid which still remain in the solution. It is now said, however, that inverted sugar is made in large quantities by treatment with brewer's yeast and without the use of acids of any kind. When added to honey in large quantities it can be detected by its great lævo-rotatory power, which, however, decreases rapidly as the temperature rises. At 23° C. a pure invert sugar solution would mark —32.5 divisions. In the present state of our knowledge it would be difficult to detect the addition of a small quantity of invert sugar to honey. From the above studies it appears that pure honey is essentially composed of invert sugar, together with a certain portion of sugars optically inactive (anoptose), water, a small quantity of albuminous matter, ash, and solids not sugar, *i. e.*, those which, while resembling sugar in chemical composition, are yet not detected in the ordinary process of analysis.

In addition to the above it appears from the results of a large amount of work done at my suggestion by Mr. G. L. Spencer, that pure honey contains a varying amount of dextrine, which in cases amounts to as much as 4 per cent.*

This investigation is still in progress, and therefore its results cannot be yet announced. The presence of dextrine in honey doubtless accounts for the phenomenon that in some samples of pure honey the lævo-rotatory power is very small, or according to some authors entirely disappears, which would not be the case except for the presence of some highly dextro-rotatory substance.

ESTIMATION OF WATER IN GLUCOSES, HONEYS, ETC.

The methods generally employed for the estimation of water in viscous liquids are so well known that it will not be necessary to describe them. Evaporation in flat dishes, with or without stirring and drying with gypsum or sand, are the processes most frequently employed.

Any one who has practiced these methods need not be told how troublesome and unsatisfactory the results are. Variations in the percentages of moisture obtained are always expected and are frequently alarming.

The following experiments have been tried to develop a method which will give concordant, and therefore comparable, results.

The success of the experiments was largely due to the even system of evaporation afforded by the steam-drying oven described below.

This box contained three horizontal layers of 1½-inch copper tubing placed at a vertical distance of 20 centimeters between them. This system of steam pipes was inclosed in a box made of soapstone. Any nonconducting material may be used for this box. Each layer of pipes is connected with the steam service and with a trap. By this arrangement all or any one of the sets of tubes can be furnished with steam. The steam is admitted by an automatic valve by which the pressure of the steam in the tubes of the box is constant, whatever the pressure

* Since this investigation was undertaken, Amthor (Rep. Anal. Chem., 1885, p. 163) has shown that honey gathered from pine forests contains dextrine often in such quantities as to become dextro-rotary. Klinger claims that this phenomenon is not exclusively confined to honey of coniferous origin. According to our observations even left-handed honey may contain marked quantities of dextrine. If this be so it can hardly be true, as W. Lenz (Chem. Zeit., 8, 613) affirms, that after fermentation honey yields no optically active substance.

may be. The top of the box is arranged like the roof of a rries a ventilating flue with a damper.

x rests on leaden supports in a lead box, over the bottom of placed a layer of pumice-stone saturated with sulphuric acid. r which enters the box must pass over this desiccating mate- herefore reaches the substances to be dried in the most favor- itions. Each layer of tubes is provided with a thermometer. is set so that no water will accumulate in the pipes and at the e as little steam escape as possible.

euce has shown that with 20 pounds pressure of steam the mid- n of tubes will give a constant temperature of 100° C. The nd top floors are a little cooler.

0 pounds pressure the central floor will show a temperature of hen the damper is closed. The dishes containing the sub- o be dried are carried in trays made of wire gauze. A box of lescribed will hold more than a hundred 3-inch dishes.

OUTLINE OF METHOD.

2 grams of the substance are taken and dissolved in alcohol. ıol should be of about 70 per cent. strength, so that about 5 ıtimeters of it will dissolve the samples taken. If the sample much dextrine a weaker alcohol may be used. The platinum short glass stirring-rod are weighed together. Fine sifted viously gently ignited, washed with distilled water, and dried)., is now poured into the dish. About 15 grams are enough. holic solution of the sample is at once taken up by capillary n. The sample is then dried in the oven for half an hour to . It is then removed, and, when cooled to about 70° C., 5 cubic ers absolute alcohol are added and thoroughly mixed with the of the dish by the stirring-rod.

le is allowed to stand for a few minutes until the absolute had opportuuity to penetrate all parts of the saccharine dish is then warmed at 70° C. to 75° C. for a few moments ry the alcohol is driven off. It is then placed in the oven l to constant weight.

DATA OF WORK.

st apts at drying were made in an ordinary air-bath, the ure being carried up to 110° C. Owing to the great diffi- uring an even temperature in such a bath, the results obtained unsatisfactory.

lowing per cents. were some of the best of those obtained with n sirup:

Weight of sirup.	Weight of water driven off.	Water.
		Per cent.
2.247	.5777	25.71
2.724	.6890	25.29
2.267	.5828	25.71
2.688	.6883	25.61
2.609	.6681	25.61
2.174	.5575	25.65

e trials differed so widely as to cause the abandonment temperature.

The next trials were made with a sample of separated honey.

The final drying (*i. e.*, after addition of the anhydrous alcoh continued for 1½ hours in the steam bath, at 98°.5.

Weight of honey.	Weight of water driven off.	Water.
		Per cent.
2.1241	.4339	20.43
2.2807	.4604	20.19
1.7997	.3662	20.35
2.0568	.4189	20.37
2.1281	.4339	20.39

To determine the proper length of time to secure the best res final drying, the following determinations were made:

The samples were taken from a can of glucose made from so seed.

Time.	Water, first dish.	Water, second dish.	Water, third dish.	Water, fourth dish.	fi
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	I
2½ hours	23.95	24.14	23.70	23.50	
4 hours	24.28	24.33	24.19	23.91	
5 hours	24.37	24.42	24.21	23.98	
6½ hours	24.54	24.58	24.47	24.29	
7½ hours	24.53	24.58	24.52	24.32	

The temperature of the steam oven remained uniformly at 98.

These results show that the final drying should be continued hours. Since an oven like the one used will hold a hundred dish has an automatic valve to maintain a constant pressure of stea therefore a constant temperature, the long drying is attended v inconvenience.

The above procedure can be safely recommended as the best r of accurately determining the free water in substances like thos tioned. It can also be employed for other bodies insoluble in but soluble in ether, &c., such as the fats. In all cases, howeve determinations should be made in duplicate or triplicate. In a of such difficulty, and often of such importance, a single trial not be regarded as final.

KUMYS.

Fermented mare's milk has long been a favorite beverage in th where it is known as "kumys." Although the Tartars and other tribes use mare's milk for the manufacture of kumys, yet it is only kind that can be employed. Since the consumption of mil has extended westward, cow's milk is chiefly employed for ma both in Europe and America. Mare's milk is considered most s for fermentation because of the large percentage of milk-sugar it contains.

Koenig* gives as the average percentage of milk-sugar in mare ..31. The same author† gives as a mean of 377 analyses of cow 4.81 per cent. lactose. Dr. Stahlberg,‡ who brought forty mare

[illegible] ingen [illegible] cit. p. 10. † Tymowski's Bedeutung des Kum

the Steppes of Russia to Vienna for the purpose of using their milk for kumys, found its percentage of lactose to be 7.26. On the other hand, ordinary mares that were kept at work gave a milk containing only 5.95 per cent. sugar.

The quantity of milk-sugar in mare's milk is great, but there is a deficiency of fat and other solids. It appears to contain fully 89 per cent. water, while cow's milk does not have more than 87 per cent.

The process of manufacture is not uniform. In the Orient the mare's milk is placed in leathern vessels; to it is added a portion of a previous brewing, and also a little yeast. In thirty to forty-eight hours the process is complete. During this time the vessels are frequently shaken.

In the samples analyzed, the milk was treated with a lactic ferment and yeast. After twenty-four or forty-eight hours' fermentation, the kumys was bottled. The bottles were kept in a cool place, not above 50° F., and in a horizontal position. When shipped to me they were packed in ice. After they were received in the laboratory they were kept on ice until analysed.

METHOD OF ANALYSIS.

Carbonic dioxide.—The estimation of the carbonic dioxide was a problem of considerable difficulty. It was evidently impracticable to attempt opening the bottle and determining the gas in a portion of the contents. Fortunately I had access to a large balance which would turn with a milligram. On this was weighed the whole bottle, into the cork of which was inserted a stop-cock such as is used sometimes with a champagne bottle. With the bottle of kumys were also weighed two drying flasks, containing concentrated sulphuric acid with their connections.

Having obtained the weight of the whole, the gas was allowed to escape slowly from the stop-cock and to bubble through the sulphuric acid in the washing bottles.

These bottles, previously to being weighed, were filled with the gas from an ordinary carbonic dioxide generator. After the gas had almost ceased to flow the bottle of kumys was frequently shaken. It was also placed in a pail of water having a temperature of 30° C. After half an hour the gas ceased to come over.

The whole apparatus was again weighed. The loss of weight gave the quantity of free carbonic dioxide in the sample. After the analysis was completed the volume of the bottle was measured. It is fair to assume that at 30° C. the kumys still contained an equal volume of dissolved CO_2. In determining the total CO_2 this volume, or its equivalent weight, was added to that obtained by direct determination.

By this method the CO_2 dissolved under pressure in the bottles is estimated separately from that which the kumys contains in solution under the weight of one atmosphere. Since it is of no importance to separate the gas into these two portions, I have given it altogether in the [illegible]-in volume—by weight and in percentage by weight.

A[illegible]ity.—The samples examined showed under the microscope the [illegible] ferment and a portion of the acidity was therefore due to acetic [illegible]. It is the custom in giving the results of analyses of kumys to [illegible]t the whole of the acidity as due to lactic acid. If ordinary [illegible]s used, and it generally is, it is possible that acetic acid may be [illegible]. This appeared to be the case with the samples in question, [illegible]distilling them a larger percentage of acid was found in the dis[illegible] could have been expected had lactic acid only been present.

I made no attempt to separate these two acids, but estimated total acidity and then represented it in terms of both acids.

The direct titration of the lactic acid in the kumys was attended wit such difficulty that the attempt was abandoned. Whatever indicat was employed, the change in color was so obscured that no sharp rea tion could be obtained.

To obviate this trouble the kumys was mixed with an equal vol of saturated solution of magnesium sulphate. After shaking the ure it was poured through a linen filter. The first portions run through were turbid. After refilling these the filtrate was quite

Better results were obtained by using with the kumys equal volum of alcohol. The filtrate from this mixture was uniformly bright. this filtrate the acid was estimated by titration with standard hydrate solution, making the proper corrections for dilution, and phenolphthalein as indicator. I would recommend this alcoholic me of clarification to all who may have occasion to determine acid in mi

Alcohol.—The alcohol was estimated by distilling 500 cubic cen meters kumys with 100 cubic centimeters water until the distilla amounted to 500 cubic centimeters. This being still turbid was red tilled with a small quantity of water. The final distillate of 500 cub centimeters was used for the estimation of the alcohol in the usual wa viz, by taking its specific gravity and calculating the alcohol from ta

Milk sugar.—The milk sugar was estimated by the method I re mended in a paper read at the Philadelphia meeting* of the Amer Association for the Advancement of Science.

Fat.—Twenty grams of the kumys were evaporated to dryness in schälchen, the whole rubbed to a fine powder and extracted with eth in a continuous extractor. The process of extraction lasted six hou

Albuminoids.—The albuminoids were estimated by evaporating grams of the material in a schälchen, rubbing to a fine powder wi soda-lime and burning with the same in the usual way.

Water.—In a flat platinum dish, partly filled with washed and dri sand, 2 grams of material were weighed and dried to a constant weig at 100° C. Following are the results of the analyses:

No. of sample.	Weight of kumys.	Volume of CO_2.	Weight of CO_2.	CO_2 by weight.	Acidity as acetic acid.	Acidity as lactic acid.	Alcohol.	Nitrogen.	Albuminoids.	Fat.	Water.	
	Grams.	*Liters.*	*Grams.*	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*	*P*
.....	747.415	2.543	5.009	.67	.....	....	.87	.431	2.69	2.21	88.81	
.....	729.376	3.140	6.186	.85	.31	47	.66	.412	2.58	2.16	89.53	
.....	768.575	3.179	6.269	.82	.34	.51	.69	.483	3.02	2.07	89.15	
.....	736.085	3.281	6.463	.88	30	.45	81	.482	3.01	1.99	89.31	
.....	746.187	3.579	6.850	91	.32	.48	.86	.423	2.64	1.87	89.97	
.....	750.247	2.973	5.057	.77	.27	.43	.70	.450	2.81	1.75	89.87	
.....	738.840	3.204	6.313	.85	33	49	.73	.462	2.89	2.44	89.01	
	752.550	3.263	6.428	.85	.....	....	.77	.450	2.81	2.34	88.87	
—	.....	.....	.....	.83	.31	.47	.76	.449	2.56	2.08	89.32	

[illegible] these results with those obtain [illegible] kumys from mare's milk and from oth

* [illegible] Journal, vol. 6, No. 5.

As a mean of fourteen analyses of mare's milk kumys, Koenig* following figures, viz:

	Per cent.
Alcohol	1.84
Lactic acid	.91
Milk-sugar	1.24
Albuminoids	1.97
Fat	1.26
Ash	.30
Carbonic dioxide	.952

ean of two samples of kumys, made of cow's milk, is given by author, as follows:

	Per cent.
Alcohol	2.64
Lactic acid	.80
Milk-sugar	3.10
Albuminoids	2.02
Ash	.45
Carbonic acid	1.03

analyses of kumys,† probably made of cow's milk, the means llows:

	Per cent.
Alcohol	1.38
Lactic acid	.82
Sugar	3.95
Albuminoids	2.89
Fat	.88
Ash	.53
Carbonic dioxide	.77

ting analyses of kumys, prepared from mare's milk, have also le by Dr. P. Vieth.‡

ares from which the milk was taken were on exhibition at the nternational Exposition for 1884. These animals were obtained Steppes of Southeastern Russia. The mares were from five to old and were cared for and milked by natives of the country ch they were taken.

milked five times daily the best of these mares gave from 4 to f milk. It is to be regretted that the milk-sugar, the most im- ngredient of milk in respect of kumys manufacture, was esti- difference. Eleven analyses of the mixed milk gave the fol- umbers:

	Minimum.	Maximum.	Mean.
ity	1.0335	1.0360	1.0349
per cent	89.74	90.41	90.06
do	.87	1.25	1.09
do	1.71	2.11	1.89
do	6.30	6.82	6.65
do	.26	.36	.31

*Koenig, Nahrungsmittel, p. 68.

†Op. cit., p. 68.

‡Landw. Versuchs-Stationen, 31, pp. 353 *et seq.*

The kumys made from the above milk had the following composition:

Sample number.	Water.	Alcohol.	Fat.	Albuminoids.	Lactic acid.	Milk-sugar.	Ash.
	Pr. ct.	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*
1	90.99	2.47	1.06	2.25	.64	2.21	.38
2	91.95	2.70	1.18	2.00	1.16	.69	.37
3	91.79	2.84	1.27	1.97	1.26	.51	.36
4	91.87	3.29	1.17	1.98	.96	.39	.33
5	92.38	3.26	1.14	1.76	1.03	.69	.34
6	92.42	3.29	1.20	1.87	1.00	.....	.35
7	91.42	2.25	1.23	1.75	.70	2.30	.36
8	92.04	2.84	1.10	1.89	1.06	.73	.34
9	91.99	2.81	1.44	1.69	1.54	.19	.34
Mean	91.87	2.86	1.19	1.91	1.04	.79	.35

Collecting the above means together we have the following comparative table:

Number.	Alcohol.	Lactic acid.	Milk sugar.	Albuminoids.	Fat.	CO_2.	Water.
	Pr. ct.	*Pr. ct.*	*Pr. ct.*	*Per ct.*	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*
1	1.84	.91	1.24	1.97	1.26	.95	*92.57
2	2.64	.80	3.10	2.02	.85	1.02	88.72
3	1.28	.82	3.95	2.89	.88	.77	*89.55
4	2.86	1.04	.79	1.91	1.19	.....	91.57
5	.76	.47	4.38	2.56	2.08	.88	88.88

*By difference.

(1) Mean of 14 analyses of kumys from mare's milk.
(2) Mean of 2 analyses of kumys from cow's milk.
(3) Mean of analyses of kumys, origin unknown, probably from skimmed cow's milk.
(4) Mean of 9 analyses of kumys made from mare's milk, London Exposition of 1884.
(5) Mean of 8 analyses of kumys from cow's milk, made by Division of Chemistry, United States Department of Agriculture.

The comparison of the above results shows that the American kumys differs from that of other countries in the following points, viz:

The percentage of alcohol is quite low and as a consequence the percentage of sugar is high.

American kumys contains more fat, showing that it has been made from milk from which the cream had not been so carefully removed as in those milks from which the European kumys was made.

Mare's milk, as will be seen by the above analyses, contains much less fat than that of the cow and more sugar, thus making it more suitable for the production of kumys. Good cow's milk, however, is suitable for the manufacture of kumys after most of the cream has been removed. Should it be desired to make a kumys richer in alcohol, some milk-sugar would be added.

The samples analyzed were kindly furnished me by Mr. Julius Haag, of Indianapolis. This kumys makes a delightfully refreshing drink. When drawn from the bottle and poured a few times from glass to glass it becomes thick like whipped cream, and is then most palatable. It is [illegible] beverage, and is highly recommended by physicians

of imperfect nutrition. Those desiring to study the therapeutic
kumys should consult the monographs of Biel,* Stahlberg,†
ski,‡ Tymowski.§

Notes on samples of kumys analyzed by the Division of Chemistry.

ple number.	Date bottled.	Date analyzed.	Sample number.	Date bottled.	Date analyzed.
.....	Mar. 24	Apr. 8	5.....	Mar. 27	Apr. 7
.....	Mar. 25	Apr. 7	6.....	Mar. 28	Apr. 8
.....	Mar. 25	Apr. 7	7.....	Apr. 1	Apr. 8
.....	Mar. 24	Apr. 8	8.....	Apr. 1	Apr. 9

REPORT O THEN OTTAWA EXPERIMENTS.

mit herewith a report of the experiments made by the Depart-
f Agriculture in the manufacture of sugar from sorghum at
, Kansas, during the season of 1885.
y be of interest to you to know what had been done in the mat-
ore you took office. The appropriation bill for the Department
culture for the fiscal year beginning July 1, 1884, approved June
contained an item of $50,000 for "necessary expenses in con-
experiments, including experiments in the manufacture of sugar
rghum and other vegetable plants." About the end of June,
e Commissioner of Agriculture informed me that he had deter-
o try the process of diffusion on sorghum cane in Kansas during
son of 1884. At that time (the appropriations could not be used
ly 1) I represented to the Commissioner that it would be im-
e to build and erect an apparatus by September 1, the time
he n ufacturing season would open. I suggested that the
be carefully investigated, trials made with different forms
-slicers, and apparatus prepared for the season of 1885. This
id not meet with the approval of the Commissioner, who ex-
a desire to comply as speedily as possible with the wish of
to have the experiments made. Accordingly, at his request,
n ives of two manufacturing firms, viz, the Colwell Iron
ny, of New York, and the Pusey & Jones Company, of Wilming-
l., came to Washington and conferred with him in respect to the
The Colwell Company refused to undertake the work at all,
Pusey & Jones Company agreed to try it and deliver the ap-
by September 15, provided the order was given prior to July
spite of the fact that the company did not undertake to finish
tery until after the manufacturing season would have begun,
t two or three months at least would have been required for the
nt d erection of the apparatus, the order was given July 14,
ahead with the construction of the apparatus. The Com-
requested me to aid the contractors as much as possible in
an outfit suitable for the purpose, but no time was afforded to
ans, since work had to be commenced at once in order that
us be ready at the time specified. I had little hope of suc-

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hungen über den Kumys und den Stoffwechsel während der Kumyskur.
e physiologische und therapeutische Wirkung. St. Petersburg.
le son rôle thérapeutique.
schen und therapeutischen Bedeutung des Kumys. München.

cess with the apparatus constructed in such a way, but, when near the end of August it became evident that it could not be finished, what little I had vanished. An attempt was then made to have the apparatus ready for use in Louisiana during the course of 1884, but this effort had also to be abandoned by reason of delay in finishing the work.

Late in the fall of 1884 the apparatus was finished and ready for inspection. I had requested that the cells of the battery be large enough to contain one ton of cane chips, and the builders furnished for this capacity a cell measuring 3 feet; bottom diameter, 3 feet; 11 inches, shoulder diameter; 1 foot 2½ inches depth of neck, and 16 inches diameter of neck; 1 foot, shoulder to bottom of neck; 6 feet deep, and containing 66 cubic feet (nearly) of space.

In the absence of any experience which would enable me to judge definitely of the matter, it appeared that the cells were sufficiently large, and they were therefore accepted. The cutters, however, appeared to be entirely inadequate to the work to be performed, and they were therefore rejected.

No further action was taken by the Commissioner in the matter except to request the company to store the apparatus during the winter, until February 13, 1885, when the Commissioner sent for me and asked me to go to New York and make a contract with Mr. B. Urner, p dent of the Franklin Sugar Company, at Ottawa, Kansas, for the er of the battery in connection with the works of his company at I met Mr. Urner at the Astor House, February 13, and we agreed the form of a contract, which I made out in duplicate to be sig by Mr. Urner and the Commissioner.

In March, 1885, the cells were sent to Ottawa, but no action was ta in respect to the cutters.

Following is a record of the work which has been done by me u your supervision. It was discovered, on consulting the books of the bursing officer, that only a little over $1,000 of the appropriation re mained available. The new appropriation of $40,000 for 1885 and 1 could not be used until July 1. On May 8, you appointed M. A. Sco to superintend the erection of the machinery and buildings at Ottawa On May 1, 1885, he was instructed to do what he could with the smal amount of funds available. In the middle of June, I went to Ottaw to assist Mr. Scovell in locating the buildings and getting the wor under way.

On the 3d of July, the new appropriation having become available, I went to Wilmington, Del., and arranged for the construction of the new cutters. A few days later you ordered of the same firm the necessary machinery to operate the cutters and convey the chips to the diffusion cells. The work of construction was hurried as rapidly as possible and the first consignment of apparatus, consisting of one cutter and shafting hangers, belting, &c., reached Ottawa on Saturday, September 4, days after the manufacturing season had commenced.

reached Ottawa on Wednesday, September 8, and the work of erec was pushed with all possible dispatch. On Sunday, September 27 the rest of the machinery arrived. During the following week, one cut er having been completed, preliminary trials were made with the ap paratus. The cutter was found to give good satisfaction, with a capacit of 6 tons per hour, giving a nicely-grooved chip well suited for diffusion

On the other hand, the cells of the battery were found to h d onl 540 pounds (by a little crowding, 1,400 pounds) instead o the opening through which the chips were to be discharged,

l, not lowing the chips to flow out freely and requiring the
ic of two s itional laborers to empty the cell. The conveyer,
chi o the cells would not work automatically, as had been
tnird man was required to direct the chips into the cells.
wing to tu lts of construction, which could have been foreseen,
ie expense or working the battery was almost double what it would be
ith proper fixtures. Add to this the additional expense occasioned
y the small capacity of the cells, and a serious increase of working ex-
enses is at once apparent.

The battery was intended by the constructors to be worked by allow-
ig the liquid to enter from the bottom of each cell, forcing the heavier
id out at the top. Numerous trials by this method showed that it
practicable. The liquid entering the cell is both lighter and
than that contained in it. The result of lighter liquid being
r was an admixture of the contained and entering liquid, which
red disastrous to close extraction. As a consequence, the connection
ith the water service had to be changed so as to permit downward
orking.

On Sunday morning, October 4, a heavy frost killed the blades of the
but did no damage to that which was fully matured.

On Tuesday morning, October 6, there was a severe freeze, ice hav-
ned an eighth of an inch in thickness. This freeze did a great
to the cane, as will be seen in the table of analysis of the mill

Wednesday, October 7, the machinery of the diffusion battery,
h hastily and imperfectly put together, was pronounced ready
r al.

On Thursday, October 8, our first trial took place. The cutters were
at 8 a. m., and work was continued until 5 a. m., Friday, Octo-
r 9. During this time 70 cells were diffused of 1,400 pounds each,
a total of 98,000 pounds. The weight of the diffused juice was 96,140
from 65 cells.

analysis of the exhausted chips showed only a trace of sucrose and
cent. of glucose. The waste water of diffusion showed a loss of
cent. of sucrose and .10 per cent. glucose. The total loss of
therefore was .10 per cent. of sucrose and .20 per cent. glucose.
xcess of glucose in these analyses is explained by the fact that the
s of exhausted chips and waste waters taken during the night
not analyzed until the next day, and meanwhile the sucrose suffered
rsion.

The total loss of sugar therefore in chips and waste waters was .30
it. This is a remarkably good extraction and the result is very
ry.

the cells could be promptly emptied, it was an easy matter to
e a diffusion every twelve minutes, and the extraction was just as
s in those cases where twice that time was employed. These re-
showed that sorghum cane diffuses with great readiness, and in this
it appears to have an advantage over the beet.

ne employed was quite imperfectly stripped and the sheaths
naining blades were, of course, treated in the cells together with
The coloring and gummy matters which they contained were
nd in the diffusion juices. It will be a very easy matter to
chips through a sieve in connection with a blower and remove
able matter.

is a table showing the details of the diffusion.

Table of diffusion.

No. of cell.	Volume of juice drawn off.	Temperature of juice, C°.	Temperature of first preceding cell, C°.	Temperature of second preceding cells, C°.	Specific gravity.
	Liters.				
1	700	22	60	77	1.050
2	700	19	61	75	1.031
3	700	24	72	64	1.038
4	700	20	60	64	1.040
5	700	19	62	59	1.041
6	700	24	.....	58	1.045
7	700	19	61	.....	1.045
8	700	25	60	58	1.042
9	700	27	58	60	1.042
10	700	27	59	58	1.041
11	700	29	64	56	1.041
12	700	24	.....	67	1.039
13	700	24	60	52	1.039
14	700	27	50	56	1.026
15	700	25	.....	50	1.036
16	700	23	50	.....	1.037
17	700	23	54	50	1.038
18	700	25	49	55	1.037
19	700	27	52	53	1.037
20	700	25	....	.....	1.035
21	700	22	58	.....	1.038
22	700	24	60	.....	1.037
23	700	24	66	54	1.037
24	700	25	67	59	1.038
25	700	25	.....	56	1.039
26	700	26	64	.....	1.040
27	700	23	64	55	1.039
28	700	23	66	55	1.040
29	700	26	65	54	1.039
30	700	25	58	50	1.036
31	700	24	56	50	1.039
32	.....	.....	64	56	1.039
33	600	26	38	59	1.039
34	600	22	.....	.....	1.034
35	600	.....	38	59	.....
36	600	19	46	58	1.036
37	600	18	54	58	1.038
38	600	22	54	58	1.034
39	600	19	56	64	1.040
40	600	28	62	.....	1.040
41	600	21	65	56	1.041
42	600	24	65	56	1.042
43	600	23	.....	56	1.043
44	600	23	65	.....	1.042
45	600	27	64	54	1.041
46	600	30	68	56	1.040
47	600	26	68	56	1.040
48	600	24	68	56	1.040
49	600	23	64	58	1.042
50	600	24	68	.....	1.042
51	600	22	68	56	1.041
52	600	23	63	54	1.040
53	600	27	.....	58	1.039
54	600	24	66	.....	1.041
55	600	24	65	57	1.042
56	600	27	68	58	1.041
57	600	25	68	57	1.041
58	600	22	59	54	1.036
59	600	21	58	54	1.041
60	600	23	.....	55	1.042
61	600	22	67	62	1.042
62	600	20	67	62	1.042
63	600	19	.....	43	1.053

Stopped for d[illegible]

† Stopped for supper.

[illegible] portions of 600 liters each were drawn off and the o[illegible] [illegible]ls [illegible] discontinued.

[illegible] of 3[illegible] cells 700 liters of juice were drawn off at e[illegible] [illegible] since the average charge of each cell

1,400 pounds of chips the ratio of diffusion juice to weight of cane was 160:100. In the second series of 31 cells 600 liters of juice were drawn off at each charge, or 1,320 pounds; the ratio of diffusion juice to weight of cane was 94.3:100. It appears from this that diffusion can be successfully practiced with sorghum cane when the weight of juice obtained is made about the same as that of the cane diffused. The mean specific gravity of the 32 charges of 700 liters each was 1.0394 at 25° C., or at 15° 1.0411, corresponding to 10.24 per cent. total solids. The average specific gravity of the juice of 32 charges of 600 liters each was 1.0405 at 25° C., or 1.0424 at 15° corresponding to 10.55 per cent. total solids. The cane varied so greatly in its composition that no estimate of the degree of extraction could be made from the analyses of the cane juices.

The following analyses were made of the diffusion juices at 10.30 a. m.:

	First time, 10.30 a. m.	Second time, 8 p. m.
	Per cent.	*Per cent.*
Total solids	10.84	15.60
Sucrose	6.19	5.90
Glucose	9.70	2.00
Solids not sugar	2.88	1.80

No analysis of the diffusion juice was made at night.

Analyses were also made of the cane juice expressed on small mill from canes taken from the yard whence the cutter carriers were supplied:

	No. 1, 10 a. m.	No. 2, 11 a. m.	No. 3, 11.30 a. m.
	Pr. ct.	*Pr. ct.*	*Pr. ct.*
Total solids	17.00	15.60	15.20
Sucrose	11.24	9.62	9.88
Glucose	2.44	2.85	3.41
Solids not sugar	3.32	3.13	1.96

The small samples taken for the above analyses showed how seriously the frost had affected the canes and how irregular they were in their composition. The peculiar odor characteristic of frosted sorghum was also very apparent in the chips as they came from the cutter. This condition of things rendered this part of the work very unsatisfactory.

The weight of coal used from the time of firing up on Thursday morning until the time of stopping Friday morning—nearly twenty-four hours—was a little over 3,000 pounds. But when the chips could be promptly removed from the cells it was possible to make a diffusion every ten minutes. Hence the whole work might have been done in seven hundred minutes, or eleven hours and forty minutes. In that case half the coal might have been saved.

The force required to do the work was—

reman (day) and one (night), at $1.50	$3 00
nen on cane carrier (day) and four (night), at $1.25	10 00
n at battery (day) and four (night), at $1.25	10 00
—n to remove chips (day) and one (night), at $2.50	5 00
s-man (day) and one (night), at $2.25	4 50
of coal, at $3.25	4 88
	1 00
,weep, &c.)	75
of diffusing 49 tons of cane	39 13

With slight changes in the battery it will be an easy matter to reduce this to $20, and if the cells are made twice as large the cost will be still less. With apparatus properly arranged the cost of diffusing a ton of cane will not be greater than 30 cents. Good machinists estimated that about 15 horse-power was used in driving the machinery and heating the liquor in the experiments made.

A study of the table of diffusions reveals some curious facts rela to the variations in the composition of the cane. Beginning with fourth diffusion and ending with the eleventh, eight cells in all, the lo lowing facts appear: The mean specific gravity of the diffusion juice a 15° C. was 1 045, corresponding to 11.2 per cent. total solids. The weigh of juice drawn off was 10 per cent. greater than the weight of can diffused; 11.2 total solids in 110 pounds would be equal to 12.33 tota solids in 100 pounds. Add to this the .30 sugar lost in chips in wate of diffusion and .15 solids not sugar, we obtain 12.77 as the total solid in cane diffused, calculated from the diffusion data. This would corre spond to 14.05 total solids in the juice as expressed by mill.

After the eleventh diffusion the cane rapidly deteriorated. The mea specific gravity from the eleventh to the thirty-third diffusion was 10.3 (circa) at 15° C., corresponding to 9.75 per cent. total solids. Proceed ing as above, the following numbers are obtained: Total solids in c diffused, 11.18 per cent. This would give for mill juice 12.35 per cen

After the thirty-second diffusion the weight of juice drawn off v 5 per cent. less than weight of cane diffused. The specific gravity o the diffusion juice at 15° was 1.044 (circa), corresponding to 11.00 pe cent. total solids. Diminishing this by 5 per cent. and adding .45 w obtain 11.00 per cent. as total solids in cane, or 12.10 per cent. tota solids in expressed juice.

Unfortunately the carbonatation pump broke after about one-third o the juice had been defecated. A careful estimate of the number o tons of cane which was worked showed that 15 had been carbonated

This yielded 4,320 pounds of *masse cuite*, containing 76.9 per cent. soli matter, or 11 per cent. (nearly) on weight of cane worked.

The composition of this *masse cuite* is shown by the following a

	Per cent.
Sucrose	53.48
Glucose	13.55
Water	23.10
Ash	4.74
Solids not sugar	5.13

This *masse cuite* was allowed to stand in cars (it was not boiled t grain) one week and was then swung out, yielding 1,420 pounds of suga about 30 per cent. of worked and dried sugar, or 95 pounds per to of cane worked.

lowing 12 pounds per gallon for the *masse cuite*, the number gallons per ton of cane was 234.

The sugar was of fine quality, the molasses of much better qualit that obtained in the usual way, and the whole product was i satisfactory

continued to deteriorate, as is shown in the following the juices from the mill of the Franklin Sugar Company:

	Friday, October 9, 4 p. m.	Saturday, October 10, 10.30 a. m.	Saturday, October 10, 4 p. m.	Monday, October 12.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
Sucrose	7.80	7.32	7.69	6.67
Glucose	3.50	3.50	3.15	3.27
Solids not sugar	2.21	3.19	3.50	3.56
Total solids	13.51	14.01	14.34	13.51

ouraging effects of the severe frost of the 6th of October afford any hope of successful continuation of the experiments. be quite impossible to work successfully a diffusion juice derived poor a source.

October 12 an analysis of some samples of cane from a different showed that the juice had been little injured by the frost. The rs obtained were the following:

	Per cent.
Sucrose	11.88
Glucose	1.87
Solids not sugar	2.44
Total solids	16.14

g that enough of such cane might be secured to allow of another the apparatus, it was determined to make another run on the ng day. The sample for analysis was taken from the west end ld, which was bordered on the west by a strip of forest and a f water of considerable size.

ntly the spot whence the sample was taken had been protected conditions from the action of the frost. Samples taken from ts of the field during the day, October 13, when the second run , show, with the exception of the first one taken from the west ne field, a serious deterioration of the cane. Following are the of juices of canes expressed by experimental mill, made during of October 13.

Number.	Hour.	Sucrose.	Glucose.	Solids not sugar.	Total solids.
	10 a. m.	10.23	2.11	2.82	15.16
	3 p. m.	8.64	2.95	2.81	14.40
	4.30 p. m.	8.54	3.11	2.89	14.54
	5.30 p. m.	8.81	2.61	2.98	14.40

y were the analyses sufficient to show the injury that had been in addition to this the chips were soft and "bleeding," and the odor characteristic of frozen cane.

with such chips was more like maceration than diffusion; never- run was made.

RUN OF OCTOBER 13, 1885.

The cutters were started at 9.30 a. m.; stopped at 6.30 p. m. Number of ho less 30 minutes stopped at noon—8 hours 30 minutes.

Number of cells of chips cut, 39. Average time for each cell, 14 minutes (near

During this time the cutters were frequently stopped to wait for the emptyi the cells.

It was found that one cutter, with moderate feed, could fill a cell (1,400 po circa) in 6 minutes.

The number of charges drawn off was 34.

The first charge was taken at 11.07 a. m. and the last one at 7.45 p. m., le minutes at noon and 30 minutes for supper—7 hours 39 minutes.

Average time for each diffusion, 13½ minutes.

COST.

Coal burned, 1,575 pounds, at $3.25 per ton ..... $
Four men on carrier, $\frac{8}{10}$ day, at $1.25 .....
One fireman, $\frac{8}{10}$ day, at $1.50 .....
One boy, $\frac{8}{10}$ day, at 75 cents .....
One team for bagasse, $\frac{8}{10}$ day, at $2.50 .....
Four men at battery, $\frac{8}{10}$ day, at $1.25 .....
One valve man, $\frac{8}{10}$ day, at $2.25 .....
Oil .....

Total ..... $

Tons cane diffused .....
Cost per ton .....

Table of details of diffusion of October 13, 1885.

Number of cell.	Volume of juice drawn.	Temperature of juice, C°.	Temperature of first preceding cell, C°.	Temperature of second preceding cell, C°.	Specific gravity.
	Liters.				
1	900	16	34	50	1.024
2	700	18	.....	50	1.037
3	700	19	48	75	1.031
4	700	18	60	62	1.033
5	700	28	56	73	1.030
6	700	26	.....	70	1.031
7	700	25	55	60	1.038
8	700	27	55	60	1.038
9	700	23	60	61	1.033
10	700	24	70	62	1.035
11	700	24	58	59	1.030
12	700	19	58	.....	1.036
13	700	21	.....	67	1.037
14	700	28	64	55	1.038
15	700	26	64	56	1.038
16	700	24	56	.....	1.039
17	700	25	.....	58	1.038
18	700	26	56	57	1.036
19	700	26	56	54	1.034
20	700	25	58	55	1.035
21	700	28	54	52	1.033
22	700	23	.....	54	1.034
23	640	28	58	.....	1.034
24	640	24	56	54	1.034
25	640	22	56	54	1.033
26	640	22	.....	54	1.033
27	640	23	56	54	1.033
28	640	22	58	55	1.033
29	640	22	56	53	1.033
30	640	22	55	54	1.033
	640	26	52	50	1.034
	640	27	54	.....	1.030
	700	41	52	50	1.024
	640	45	50	51	1.021

total weight of juice delivered to liming tanks was 24,110.7 ams, or 52,043.5 pounds.

weight of cane in the 34 diffusion cells was 1,400 multiplied by 7.600. Therefore the weight of juice drawn off to cane removed, to 100.

average composition of the diffusion juices will be shown by the ng analyses:

Diffusion juices.

Number.	Number of diffusion.	Sucrose.	Glucose.	Solids not sugar.	Total solids.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
	4	4.86	1.69	1.78	8.33
	14	5.94	2.00	2.20	10.14
	21	4.99	2.81	1.64	8.94
	25	4.76	2.25	1.55	8.56
	31	3.91	2.16	1.63	7.70
an		4.89	2.08	1.76	8.74

urity coefficient, 56 per cent.

Percentage sucrose left in exhausted chips and waste waters.

Number.	Number of diffusion.	Chips.		Total sugars.
		Sucrose.	Glucose.	
		Per cent.	*Per cent.*	*Per cent.*
	4	*.06	.062	.122
	14	.049	.031	.080
	31	.068	.068	.146
	25	(†)	.126	.126
an				1.119

first analysis above the sucrose was sought for by a polariscope, but so little was present tation could be observed. It is fair to presume from a study of the analyses which follow r cent. sucrose was present.

nalysis the chips were left over night, and in the morning no sucrose could be found. It inverted, and appears therefore with the glucose.

WASTE WATERS.

weight of water discharged with each cell was nearly one-third than that of the chips; therefore the percentages found are in- by one-third to represent the real loss.

Number.	Number of diffusion.	Sucrose.	Glucose.	Total sugars.	Total sugars increased.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
	4	Trace.	Trace.		
	14	Trace.	Trace.		
	21	.008	.019	.022	.029
	25	Trace.	.028	.028	.032
					.0305
of sugars in chips and waste					.01221

The exhaustion of the cane, therefore, is practically perfect and superior to all expectation. With unfrozen cane I do not think it be so perfect.

After October 13 the character of the cane made any further ments useless, and the work for this season was therefore discon The juice from the second run was all carbonated, but the process slow and the juice had to stand so long in contact with the lime t product was of a much darker color than the first. The total we *masse cuite* obtained, 89 per cent. being solid matter, was 5,510 p For the 23 tons of cane carbonated this gives a yield of 20 gall ton.

Much loss, however, was occasioned by the frequent transfer juice in order to secure its entire carbonatation and at the same keep it out of the way of the other products in the factory. This *cuite* was of so poor a quality that at the date of writing (October attempt has been made to swing it out.

CARBONATATION.

As pointed out in the experiments in carbonatation described letin No. 3, it is evident that the process so long and so succe practiced with beet juice is also capable of giving good result cane juices. The process is a very simple one, and consists in to the diffusion or expressed juice a large excess of lime and afte precipitating the greater part of it with carbonic acid. The w then sent to the filter press, where the precipitated carbonate and impurities are separated from the juice.

I had not expected to make a trial of this process on account fact that I feared the appropriation would not be sufficient to c both experiments. On arriving at Ottawa, I learned that the company had two filter presses, an air-pump, and two pans, whic be arranged so as to give the process a trial on a large scale. A ingly I had a furnace constructed for furnishing carbonic acid, a rest of the apparatus put into shape for the experiments. The was designed by Mr. G. L. Spencer, who also had a general supe of the entire work.

Our former experiments had shown that the process had to be on somewhat differently from that of the beet juices, owing to th ence in sorghum juice of a large percentage of glucose.

Our first experiments were made with the diffusion juices o Thursday, October 8. At that time the effects of the freeze h shown themselves to any great extent. It was found that about cent of CaO (lime) was sufficient to produce a perfect defecation juice. On that day, as nearly as we could estimate it, about pounds of juice were carbonated, with the most gratifying result juice came from the filter press perfectly limpid and of a delicate color. After passing through a sulphur box this juice was sen evaporators and reduced to a *masse cuite*, which, in color, puri taste was greatly superior to the best product obtained by th method. Unfortunately our improvised air-pump broke down ddle of the work, which caused the loss of more than half of nsion juice obtained which had already been limed for carbon

The carbonatation of sorghum juice, however, demands the g care. If too little lime is added the precipitate does not settle and filtration is slow and imperfect. The carbonatation must be ed until all but 0 2 per cent. of the lime has been removed. ... this remains behind it will darken up and become bitter

ing. If less than this quantity is left the impurities appear to be redissolved and a green scum forms on top of the still liquor instead of sinking with the precipitate. With the help of proper test reagents a little experience will enable the operator to carry the carbonatation to a successful completion.

It is found, also, that the temperature during carbonatation should not be allowed to rise above 40° C. When the carbonatation is completed the juice is raised as rapidly as possible to the boiling point and sent at once to the filter press. If allowed to stand the liquor will quickly darken. Foaming is prevented by the addition of a little lard and by a jet of steam from a perforated pipe near the top of the pan.

Analyses of carbonated juices.

Number.	Sucrose.	Glucose.	Solids not sugar.	Total solids.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
1	5.25	1.18	2.25	8.68
2	6.51	1.47	3.00	10.98
3	4.99	0.48	3.72	9.19

fi and second of these represent successful carbonatation. ed juice was all that could be desired in color and flavor. The te made from it was also of the best quality and has already b ted.

third analysis represents an unsuccessful carbonatation. Too lime was left in the liquor, and the *masse cuite* was black and

ll 100,000 pounds of juice was carbonatated, and I do not hesitate t that this process of defecation offers every evidence of being the which should be brought into general use. In large sugar factohe ving in scums alone in one season would pay for the carbonapl t.

mil th a statement of the analyses made of the juices from s mul during the progress of our work:

Analyses of sorghum juices.

Date.	From first mill.				From second mill.			
	Sucrose.	Reducing sugar.	Solids not sugar.	Total solids.	Sucrose.	Reducing sugar.	Solids not sugar.	Total solids.
	Per cent.	*Per cent.*	*Pr.cent.*	*Pr.cent*	*Per cent.*	*Per cent.*	*Pr.cent.*	*Pr.cent.*
September 9	9.40	.....	.....	14.75	9.55	.....	.....	14.77
September 11	9.72	2.94	2.44	15.30	8.65	3.25	3.00	14.90
September 12, 7.30 a. m	10.48	2.58	3.04	16.10	9.12	2.83	4.35	16.30
September 12, 11 a. m	7.70	3.54	2.36	13.60	8.55	3.20	3.60	15.30
September 12, 3 p. m	9.87	2.20	3.53	15.60	10.59	2.54	2.17	15.30
September 14, 10 a. m	10.78	2.68	2.37	15.78	9.00	2.77	3.83	15.60
[illegible]mber 15	11.17	2.10	2.88	16.15	10.51	2.70	3.54	16.75
[illegible]ber 16	9.39	3.43	3.68	16.50	8.86	.....	.....	15.32
[illegible]ber 17, 10 a. m	9.18	3.49	2.10	14.77	8.09	3.62	3.26	14.97
Aver	9.74	2.87	2.80	15.38	9.21	2.99	2.97	15.47
[illegible]ent of purity	63.3				59.5			

the above it is seen that the juice from the second mill is slightly to that from the first. In quantity the two mill juices are about

Analyses of mixed mill juices.

Date.	Number.	Sucrose.	Reducing sugar.	Solids not sugar.
		Per cent.	*Per cent*	*Per cent.*
Sept. 9	1	9.39	...	...
Sept. 10	2	8.68	...	...
Sept. 10	3	10.32	...	...
Sept. 10	4	8.35	3.00	3.15
Sept. 10	5	9.38	3.24	3.78
Sept. 14	6	12.26	1.98	2.82
Sept. 15	7	11.29	2.23	2.80
Sept. 17	8	7.87	3.91	4.03
Sept. 21	9	10.49	...	...
Sept. 25	10	10.13	2.77	2.84
Sept. 28	11	9.61	3.74	2.94
Sept. 28	12	10.09	2.71	2.61
Sept. 29	13	9.68	2.87	3.11
Oct. 1	14	9.77	2.54	2.59
Oct. 3	15	10.59	2.85	1.80
Oct. 5	16	9.88	3.14	3.18
Oct. 6	17	9.76	2.88	2.54
Oct. 6	18	9.51	2.80	2.54
Oct. 7	19	9.84	3.15	2.31
Oct. 9	20	7.80	3.50	3.21
Oct. 10	21	7.32	3.50	3.19
Oct. 10	22	7.69	3.15	3.60
Oct. 12	23	6.67	3.27	3.56
Oct. 14	24	5.72	3.96	3.20
.. ..	Mean	9.23	3.04	2.87

The above is a fair exposition of the quality of the juices work the company during the season. It shows that there is much ye done in the culture and improvement of the cane before a prod obtained which is favorable to the production of a large quantity of per ton. I am told by the officers of the company that the seas been unusually unfavorable, a late wet spring and a remarkably freeze combining to prevent the cane from reaching maturity.

The mean coefficient of purity of the juices worked by the comp 61.3. I have every reason to believe that by proper culture, ferti and selection, sorghum cane can be produced in which the juic have a coefficient of purity of 75 to 80. The importance of securin a cane is even greater than that of extracting all the sugar and pr defecating the juice.

In continuing the experiments in topping the cane as soon as th heads appear, as described in Bulletin No. 5, the following result obtained with canes grown as nearly as possible on the same k soil and under the same conditions of culture:

	Topped and suckered cane.				Topped canes not suckered.				Canes not topp		
	Su-crose.	Reducing sugar.	Solids not sugar.	Total solids.	Su-crose.	Reducing sugar.	Solids not sugar.	Total solids.	crose.	Reducing sugar.	Solids not sugar
	Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per c*
ept. 14	13.23	2.25	2.15	19.62	12.78	2.66	2.26	17.70	13.01	2.13	2.1
15	13.31	2.06	2.66	17.68	12.59	2.22	2.67	17.48	11.85	2.52	2
16	12.87	1.65	2.13	17.65	12.90	1.93	2.96	17.29	12.16	2.16	2
17	10.37	3.05	2.33	15.75	12.77	1.92	2.76	17.45	14.60	1.29	3.
18	13.24	1.93	3.13	18.40	12.88	2.68	1.58	17.12	13.25	2.59	1.8
19	12.59	1.98	2.79	17.36	13.00	2.06	3.00	18.06	11.52	2.31	2.6
20	13.49	1.50	3.22	18.51	12.33	2.11	2.97	17.41	12.18	2.06	2
21	12.57	1.57	3.14	17.28	11.90	1.76	2.69	16.25	12.74	1.45	2.
22	11.11	1.94	2.80	15.75	11.42	2.02	3.26	16.70	10.89	1.99	2
23	11.97	1.76	[illegible]	16.44	12.16	1.58	2.49	17.17	11.26	2.06	2
age	12.45	1.99	2.83	17.26	12.48	2.09	2.76	17.31	12.15	2.06	2
efficient	72.1				72.00				72.60		

From the above results it is seen that no appreciable increase of sucrose is obtained by topping and suckering the canes, and therefore it is useless to make further experiments in this direction.

SOLUBLE MATTER AND WATER.

total soluble matter in the clean canes, obtained by repeated ex- th water, and drying and weighing the exhausted residue, ru in the following table:

Soluble matter in canes.

No. of determination.	Per cent.	Date.
1	88.42	September 17.
2	88.32	September 18.
3	90.70	September 19.
4	90.92	September 19, duplicate.
5	90.45	September 28.
6	90.40	Do.
7	88.80	Stripped and topped.
8	87.80	
9	89.80	Topped, not suckered.
10	89.80	
11	91.80	Not touched.
12	91.00	
13	91.80	East field.
Average	90.00	

WAHL VACUUM-PAN.

A new kind of evaporator, for the continuous reduction of thin to or in partial vacuo, built by Wahl Brothers, of Chicago, was by the company. The pan worked well and appeared to or no inverting effect on the sucrose, as is indicated in the ing analyses:

Effect of Wahl pan evaporation.

Number.	Thin liquor before passing through pan.				Same after passing through pan.			
	Sucrose.	Reducing sugar.	Solids not sugar.	Total solids.	Sucrose.	Reducing sugar.	Solids not sugar.	Total solids.
	Per cent.	*Per cent.*	*Per ct.*	*Per ct.*	*Per cent.*	*Per cent.*	*Per ct.*	*Per ct.*
1	10.29	3.53	3.28	17.10	37.44	12.91	8.95	59.30
2	11.20	4.23	3.44	18.87	40.28	14.91	12.81	68.00
3	11.18	3.70	4.02	18.90	31.09	10.37	11.76	53.22
4	10.87	4.51	2.99	18.44	20.54	13.13	2.11	35.78
5	10.24	2.93	2.58	15.75	26.74	10.32	8.24	45.30
Average	10.76	3.74	3.26	17.81	31.22	12.33	8.78	52.32
Coefficient of purity	60.4		.....	.....	.....	59.6		.....

EXPERIMENTS IN AIR EVAPORATION.

ion v called, in Bulletin No. 5, to two forms of apparatus de- w n sirup to sugar by means of hot air and at a temper- ough to prevent any notable inversion of sucrose.

se forms of apparatus was designed by Mr. Stuart, of Iowa, by Mr. Denton, of Kansas. The hope that a trial of these

apparatus might result in showing that sugar for general family use might be made in a small way, and without expensive apparatus, led to a trial of both forms.

This trial was under the immediate supervision of Mr. A. A. Denton. The results of the experiments were not satisfactory.

The Stuart apparatus gave fairly good results as far as temperature is concerned. The sirup was heated by steam coils in the bottom of a long rectangular tank, through which air was forced by devices described in Bulletin No. 5, page 178.

In the experiments made at Ottawa the temperature of the body of the sirup was kept at about 180° F. Near the end of the concentration however, it was impossible to avoid a little scorching of the mass in contact with the pipes.

The apparatus, however, is extremely simple and cheap, and I think with rich cane might be made to yield a fair quantity of sugar.

The apparatus constructed by Mr. Denton consisted of a rectangular box 28 feet high, the other dimensions being 4 feet and 2 feet respectively. In this box was a double endless chain carrying two sets of galvanized iron pieces. These pieces dipped into the sirup below and thus carried it towards the top of the shaft.

A blower attached to a heating chamber containing 400 feet of pipe threw a current of hot air into the bottom of the apparatus, which ascending through the box, came in contact with the thin sheet of liquid spread over the galvanized iron surface.

Apparently the heating surface was not sufficiently great, for it was almost impossible to raise the temperature of the liquid within the box to 100° F.

The experiment was therefore abandoned, but Mr. Denton thinks with a proper heater it will prove successful. The low specific heat of air will render it quite difficult to keep the temperature high enough to allow the escaping air to carry off any considerable quantity of aqueous vapor; but it is possible that some such device will secure the production of sugar on a small scale.

I still, however, adhere to the opinion, expressed in Bulletins No. 4 and 5, that sugar making on a small scale is not the rational method of procedure. The experience of the whole world has been that successful sugar making implies the investment of sufficient capital to secure the best machinery and to work in the most economical manner.

The experiments of the present season have not shown any sufficient reason for a change in that opinion.

DEFECATION WITH ACID ALBUMEN.

A trial was also made with the Wilcox method of purifying sorghum juice with acid albumen.

The method employed was communicated to me by Mr. Wilcox, the inventor.

Following is his description of the process:

"Our first care is that the sorghum juice is from *freshly* cut cane, as a few hours makes a great difference in its sugar-yielding qualities, as you are aware.

"The fresh juice being placed in a defecator and while in the cold state, we add grains of dried egg albumen dissolved in cold water for each pound of juice, and thoroughly incorporate with the same. We next slowly add enough of a solution consisting of one part of 66° B. sulphuric acid and seven parts of water, till litmus shows slightly more red than it would if the juice were simply in the natural state.

"The correct acid point is very important, and to determine this we take some of the contents of the defecator in a test tube and heat it over a lamp to the boiling poi

. If the liquid is vigorously stirred a few moments, a greenish precipitate and a clear liquor remain; if, on the other hand, not enough of the acid solu- en added, the liquor will be cloudy in appearance and contain but a small f precipitate. If such is the case, dip a small splint in the acid solution and contents of tube till a good precipitate takes place. If too much acid solu- en used in the defecator, no precipitate will form in the tube, nor will the agulate, a condition which is very bad, requiring the use of lime at an im- e to correct. This tube test will give the exact state of the contents of the nd by it the correct acid point obtained.
at is now raised till the contents of the defecator stand at a temperature of hen it is shut off; we now add milk of lime (which will form more precipi- ie liquor is exactly neutral; good, sharp, caustic lime should be used, as it will f it, and our experience shows that the less we have to use the better. oint at this stage is to see that the liquors do not grow alkaline after they l, as lime acts somewhat slowly; if such should be the case, add enough olution till litmus changes to a purplish blue, but the neutral point must to cause a full precipitation so as not to be bothered with it during con-

efecation we pass the juice into a vessel called a separator, of the same ca- the defecator, and collect the precipitate in the bottom of the cone, from s drawn off through the faucet, thereby saving a great deal of labor in if the liquor should still show any cloud, then strain it through a filter g filter, when it will be clear and brilliant, of a light lemon color."

unately we did not have time to make a trial of the process r the cane had been injured by frost. I am of the opinion that ess carried out as described above will not work any injury to se in the juice.
sult of the defecation showed that the juice filtered through er was limpid and of a light lemon color. About 2,000 pounds sent to the filter press, but in spite of every endeavor it would through. In a few moments the cloths were completely closed ie highest pressure obtainable no liquid could pass. The diffi- ith the Wilcox method are therefore not chemical but mechani- nnot suggest any method by which these mechanical difficul- e overcome.
cluding this report I desire to properly thank Prof. M. A. nd Mr. James Forsythe for the services they rendered in erect- chinery, and my assistants, Messrs. Clifford Richardson, G. r, and John Dugan, for the aid they gave in the laboratory e factory.
also to thank Professor Swenson and Mr. W. L. Parkinson, ist and the manager of the Franklin Sugar Company, for the rtesies shown us by them, and for the readiness with which us every facility of manipulation in their power.

GENERAL CONCLUSIONS.

neral results of the experiments may be summarized as fol-

t process of diffusion 98 per cent. of the sugar in the cane ted, and the yield was fully double that obtained in the ordi-

fficulties to be overcome in the application of diffusion are nanical. With the apparatus on hand, the following changes v in order to be able to work 120 tons of cane per day:
sion cells should be made twice as large as they now are, ic feet capacity.
ng through which the chips are discharged should be y possible of the same area as a horizontal cross-sec-

(*c*) The forced feed of the cutters requires a few minor changes, in order to prevent choking.

(*d*) The apparatus for delivering the chips to the cells should be remodeled so as to dispense with the labor of one man.

(3) The process of carbonatation for the purification of the juice is the only method which will give a pure limpid juice with a minimum of waste and a maximum of purity.

(4) By a proper combination of diffusion and carbonatation, our experiments have demonstrated that fully 95 per cent. of the sugar in the cane can be placed on the market, either as dry sugar or molasses.

(5) It is highly important that the Department complete the experiments so successfully inaugurated, by making the changes in the diffusion battery mentioned above and by erecting in connection with it a complete carbonatation apparatus.

WORK UNDER THE DIRECTION OF THE ASSISTA[illegible] CHEMISTS.

The results of the continuation of Mr. Clifford Richardson's work ur the cereals, which he has had in charge for several years, he has marized in the following pages:

THE CEREALS.

The study of the cereals of the country, which has been in p for some time, has been continued and extended during the

It was originally undertaken with the idea of discovering the which brought about such great variation in their chemical comp and physical properties in order that the farmer might profit by knowledge of the conditions under which the best grain was grown of the localities where the most favorable conditions existed, the field experimenter might have the aid of a scientific and cu study of his results.

CORN.

The first conclusions reached were in regard to corn and wheat.

Corn was found, as all are well aware, to vary very largely in its physical properties, but its chemical composition was not by any so changeable, or they were at least within much smaller limits was the case with wheats.

A study of the conditions of growth showed that this is in to an extended period of vegetation and the great length of compared with other cereals. It is thus enabled to secure from any soil supplies of food which would be unavailable to wheat, during its slow growth store up the materials for the formation of grain, each in its proper relative proportion.

The physical properties of the grain, especially its size, are of cou much influenced by the fertility of the soil and length of season. In verage weight of one hundred kernels of dent corn for the entir United States being 36.748 grams, individual samples were found ary from 13.859 grams in one of the Northern States to 64.102 in nessee. There would be, therefore, but little doubt th more ould be produced to the acre in Tennessee and the S han in the North if other conditions were the same. Th we not the case and experiments upon the question of the effect of cum

l production of corn. It proves to be the most important much so that, while the size of the Tennessee kernel is twice s that grown in the North, the yield per acre is less.

Yield of corn by groups of States in 1879 *and* 1883.

[J. R. Dodge, Annual Report, 1884.]

Group.	1879.	1883.
ppi States	37.5	29.4
	34.3	33.0
w Jersey, and Pennsylvania	33.2	25.9
	32.9	25.0
	27.4	24.5
in region	19.5	18.6
yland, and Virginia	18.6	16.6
States	15.6	16.3

Yield per acre of corn [1879].

e.	Yield.	States.	Yield.	States.	Yield.
	31.0	Georgia	9.0	Iowa	41.6
re	36.9	Florida	8.8	Missouri	26.2
	36.5	Texas	11.8	Kansas	30.9
	33.7	Arkansas	18.6	Nebraska	40.1
	31.4	Tennessee	21.6	Alabama	12.4
	33.7	West Virginia	24.9	Mississippi	13.6
	33.2	Kentucky	24.1	Louisiana	13.3
	33.4	Ohio	34.1	California	27.8
	19.3	Michigan	35.3	Oregon	22.5
	16.5	Indiana	31.4	Nevada	26.5
	24.0	Wisconsin	33.7	Colorado	19.8
a	12.2	Illinois	36.1		
a	9.0	Minnesota	33.8		

ove data show that the yield in the South is far inferior to that orth, that a warm climate and long period of growth, while g a large kernel, tends to give a gross plant with but few ears. nces can hardly be due to soil, and in fact are far too marked explanation.

n has its due effect is evident from the fact that with much d cultivation the newer and richer soils of the trans-Missis- produce a larger number of bushels to the acre than the worn-out soils of the East.

hat has been learned in our investigations it is apparent, there- climatic conditions being favorable, or at least not modifiable, vement of our corn crop must be brought about by increasing t per acre, the weight per bushel, and the size of the kernel, al properties easily watched by the practical farmer. It will sary for him to employ the chemist to determine the chem- tion, as it will be seen is the case with wheat, owing to the us composition is but slightly affected by environment. All the improvement of our corn crops much more easy of ac- and places it in the hands of every farmer to do some- in this line of work. He has only to select the variety as his experience goes flourish best on his soil, and ection so modify the physical properties as to improve a large field for good practical work.

WHEAT.

Our investigations of the wheat grain have shown that it is very variable in its chemical composition, and that its variations are characteristic of certain localities. For example, the percentage of albuminoids increases from the Atlantic coast toward the West, while in Oregon the lowest percentages of nitrogen are found. The physical properties, color, size, and hardness, vary, too, to such a degree that it is not difficult to decide at a glance where the most characteristic varieties come from. Wheats from Dakota, Colorado, and Oregon are so entirely different in their appearance that they can be distinguished even in a photograph.

A study of the causes of these variations and distinctive characters shows that the wheat grain, of all the cereals, is the most susceptible to its environment, and to this fact is due the peculiarities which are found in various parts of the country.

It is a plant of rapid growth, the grain being formed and ripened in a very few weeks. For this reason climate and all meteorological conditions produce a marked effect upon the grain, while the soil is equally a conditioning agent in that the food supply must be immediately available and near the root. The plant cannot, like corn, go seeking, with long roots, for its food. As climatic influences are paramount, it will readily be understood that variations in the characteristics of the seasons in the same locality will have a great influence on the grain, and this is well illustrated by a series of analyses covering the crops grown for several years in Colorado during which the seasons were quite variable.

The named varieties of wheat are numbered by hundreds, perhaps by thousands, but they are merely evidence of the readiness with which modifications of the grain can be produced by changes in the conditions of growth. There is nothing definite or lasting in their characteristics, and, as has been observed on the Continent, the transfer of a variety from one locality to another is accompanied by changes in its characteristics approaching those of its new surroundings.

Among our wheats, as has been said, it is not difficult to tell from its external characteristics what part of the country a specimen comes from; and among the most marked are the Colorado wheats of Professor Blount, the Oregon and the Northwestern grain.

The Oregon grain is a large light yellow, plump and handsome grain of a very starchy nature. It owes its peculiarities, I believe, to the fact that it is ripened slowly in a moist climate, and is as different from the Eastern grain as has been found to be the case with beets under similar circumstances. A cool and moist summer furnishes the best conditions for the formation of the carbohydrates.

Colorado grain is a contrast to that of Oregon, in that it is larger. The berry loses the starchy appearance and becomes more glassy, amber-colored. It is rich in nitrogen and is, theoretically at least, the most perfect grain among our samples. It should be stated that such wheat has only been produced on an experimental scale.

A still greater contrast is presented by the spring wheat from Minnesota and Dakota. It is the smallest of all, dark colored, in now plump, and very hard and rich in nitrogen. It is in fact the richest grown in this country, reaching in one instance to 18 per cent. albuminoids, and produces, therefore, a very stiff flour. Its character is the climatic conditions in the same way as with the Oregon wheat

ring from that in just the direction in which the two climates
.t ripens without an opportunity to fill out with starch, and con-
y is relatively rich in albuminoids. The same number of grains
c tain any more nitrogen, absolutely, than an equal number
grains.
nishing to see, however, the result of sending seed wheat from
on and from Minnesota to Colorado and growing them there
years. The two in a short time so nearly resemble each
they can be distinguished only by their color. A few more
uld make them still more similar. They have assumed all the
o characteristics, and no better illustration of the susceptibility
; to its environment could be asked than to look at the samples
ave proved this.
calities mentioned possess characteristics more marked than
ers, but in a minor degree the crops of the middle West, the
d the South can be distinguished. It must be said that in the
1 of latitude the changes in this grain, as with corn, is more in
l per acre and size than in the chemical composition. They are
arked, however, as can be seen in the following table:

Yield per acre of wheat [1879].

tes.	Yield.	States.	Yield.	States.	Yield.
.....	15.2	South Carolina.....	5.6	Wisconsin	12.8
shire	15.0	Georgia	6.6	Minnesota	11.4
.....	16.3	Florida.....	5.2	Iowa	10.2
tts	16.4	Louisiana	3.4	Missouri	12.0
d.....	14.1	Texas	6.8	Kansas.....	9.3
.....	17.6	Arkansas	6.2	Nebraska	9.4
.....	15.7	Tennessee.....	6.1	Alabama.....	5.7
.....	12.7	West Virginia.....	10.2	Mississippi.....	5.0
ia	13.5	Kentucky	9.8	Nevada	18.9
.....	13.4	Ohio	18.0	California	15.8
.....	14.1	Michigan	19.5	Oregon.....	16.8
.....	8.7	Indiana	18.0	Colorado	22.0
ina.....	5.2	Illinois.....	15.9		

sirable in this connection to call attention to the fact that
arters of the wheat crop of the country is produced in ten
nd that its average composition is influenced by their situation.
tates were, in 1879, according to the census, Illinois, Indiana,
ichigan, Minnesota, Iowa, California, Missouri, Wisconsin, and
vania. Our conclusions for the average production must be
onately influenced by this fact.
ariations which take place in the same locality in any one va-
m year to year are found to be due chiefly to difference in the
and the impressions which they make upon the grain are some-
sting. Some varieties, which improve on their advent to a new
, or at least hold their own for a number of years, gradually de-
: from careless cultivation or for natural causes beyond the con-
farmer. It is unnecessary to remark on the ease with which
cultivation or lack of care in selection of the seed is productious results. In the way of natural and unavoidable causes,
ing the active period of growth produce the greatest changes
tion of the grain. The effects produced may be of differaccording to the stage of formation of the grain, but the
case are not recovered from for some time unless a change

is made in the seed used for the following crop. Reversion is muc more easily accomplished than improvement.

In Colorado, a storm in 1883 prostrated the plant at a time when th injury interfered with assimilation of its nitrogenous constituents, a though afterwards the grain filled itself out fairly well with This grain, used as seed for the ensuing year, gave a crop which showed lack of nitrogen, and although a certain recovery had c made, the depreciation in its chemical composition was very eviden In the same way, in Ohio, a storm prevented the grain from being fille out with starch, leaving it small and shriveled, and relatively rich i nitrogen. These cases show the necessity of obtaining new seed wl any injury happens to the crop of the preceding year.

An examination of the chemical composition of wheat grown with tl greatest care on the same land for a number of years seems to show th many varieties depreciate from their original valuable qualities. It an old idea, and many farmers practically change their wheat now ar then, but the change in these cases is oftener necessitated by careles ness in cultivation than by natural causes. In Colorado quite a numb of the varieties, cultivated with great care by Professor Blount, ha steadily depreciated after improving during their first year in the ne locality. Others have held their own, and some have improved. Tl result of our analyses has, however, shown that care alone is not suf cient to improve a wheat. It must be at least fairly well suited to tl locality in which it grows.

The data of the first three years of the experiments have been alread published; those of last season's work show that, while the results the storm of the previous year were not entirely obliterated in 18 nevertheless some wheats were produced which were remarkable n their size and weight. One, for example, weighed 6.620 grams per grains, and the general increase has led to an investigation of the r lation of size and other properties to that of weight per bu al wheat from various parts of the country and the relations of ex to each other. The latter are not at all coincident, as may be s n the following figures and numbers denoting different varieties:

Extremes among Colorado wheats of 1884.

	Highest.	Serial number.	Lowest.	Serial numbe
Yield per acre	86.6 bu.	3560	21.3 bu.	[illegible]
Weight per bushel	68.6 lbs.	3576	62.2 lbs.	
Weight per one hundred grains	6.620 grams.	3536	3.160 grams.	
Albuminoids	14.88 per ct.	3559	9.45 per ct.	

The weight per bushel is apparently dependent on several cause High weight is almost, if not always, an evidence of high quality, not always an evidence of a large and plump grain. The hard r spring wheat of the Northwest, which is smaller in size and not as pl as many other varieties, is heavy in its weight per bushel, while n arge full wheats of Oregon, which are very starchy, are light. T ollowing da show some of the variations:

Weight per bushel of hard, soft, and immature wheats.

HARD RED SPRING WHEATS.

mber.	State.	Weight per—		Yield, per acre.	Quality.	Albuminoids.
		Bushel.	100 grains.			
		Lbs.	*Grams.*	*Bushels.*		*Per cent.*
.....	Dakota	65.3	3.312	25.5	Good	14.53
.....	....do	66.5	2.802	26.5	No. 1.....	15.23
.....	....do	66.2	3.368	27.0	....do	17.33
.....	....do	65.3	3.389	27.3	....do	14.60
.....	....do	65.2	2.921	36.0	....do	14.35
.....	Minnesota	65.5	2.780	(?)	....do	14.35
.....	Dakota	66.8	3.700	(?)	... do	16.28
.....	Manitoba	67.1	3.465	(?)	....do	13.48
.....	Dakota	63.4	3.074	(?)	....do	18.03
.....	Minnesota	64.9	3.334	(?)	Frozen.....	13.65
.....	....do	64.3	2.926	(?)	No. 1	18.83

SOFT WHITE OREGON WHEATS.

.....	Oregon	57.2	4.253	(?)	Extra.....	8.58
.....	.....do	59.8	5.144	(?)	....do	8.05

IMPORTED WHITE WHEAT.

.....	.....	62.2	4.710	.....	Extra.....	10.33

OTHER WHITE WHEATS.

.....	Pennsylvania.....	60.4	2.710	44	Medium.....	9.38
.....	Missouri.....	62.7	3.860	.....	....do	11.19
.....	Pennsylvania.....	62.1	2.526	.....	....do	10.50
.....	Michigan	62.1	4.196	.....	....do	10.85
.....	Maryland.....	63.4	3.077	.....	....do	10.85
.....	North Carolina ...	61.2	3.653	.....	....do	10.15
.....	(?)	61.4	(?)	.....	....do	.....
.....	West Virginia....	64.5	3.392	15.0	Good	11.80
.....	Virginia	65.0	3.565	20.0	....do	12.60

IMMATURE AND POOR WHEATS.

.....	Alabama	52.3	2.011	3.5	Poor	10.85
.....	....do	62.3	3.710	10.3	Fair.....	10.85
.....	....do	49.8	2.242	5.2	Bad.....	9.98
.....	....do	63.5	3.486	5.3	Fair	11.03
.....	....do	48.1	2.166	2.8	Bad.....	9.80
.....	... do	57.0	2.675	1.6	Poor	11.88

AVERAGE OF FORTY-TWO POOR WHEATS FROM OHIO IN 1883.

.....	.....	56.6	3.458	39.3	Shriveled	12.89

TS WITH HIGHEST AND LOWEST ALBUMINOIDS AND LARGEST SIZE.

.....	Dakota	63.4	3.074	Large..	Highest albumen	18.03
.....	Washington	63.5	2.584	...do ...	Lowest albumen..	7.70
.....	Colorado.....	64.4	6.620	...do ...	Largest size	12.08

HIGHEST WEIGHT PER BUSHEL.

.....	Colorado.....	68.6	4.060	.....	Hard red....	12.95

LOWEST WEIGHT PER BUSHEL.

.....	Alabama.....	48.1	2.166	.....	Poor	9.80

From these figures it appears that the hard spring wheats will ave age about 65.5 pounds per bushel, the soft white wheats of Oregon 58. the ordinary soft grain of the East 62.5, the poorly matured samples Alabama and Ohio 55.5 and 56.6, while the large plump grain of Col rado reaches 65.2 pounds per bushel. Weight per bushel is evidentl then, an indication of good quality.

The averages for different seasons in Colorado vary directly as th percentages of albuminoids, although among the less fully develope grain the lighter often contain more nitrogen from lack of starch, as i the case of the crop of 1883. This was found to be the case by Law and Gilbert in their experiments. It does not always hold true, as ma be seen among the Alabama wheats and some others, while the Oreg samples, finely matured, rich in starch, and low in nitrogen, are spongy and light in weight.

The weights per bushel contained in the preceding table seem to l very large when compared with the average estimates obtained by statistician of this Department from a large number of reliable corr spondents last year. That they are actual weights of the samples e amined has been proved, however, by experimenting on wheat and o of known weight per struck bushel, and if the estimates are correct must be assumed that the samples sent to the Department are not ave age ones. For instance, C. A. Pillsbury considers 56 pounds an a age for Minnesota red. William Wheatly thinks that Maryland wl varies from 59 to 62 pounds, according to locality. The State agent Georgia puts the figures for ten years at 54 to 55 pounds, and the a of Kansas at from 53 to 57 pounds per bushel. The difficulty of col ing average samples will always be met with, as there is always a desi to send the best. Farmers insist on deceiving themselves and others this way.

The results of our investigation will, it is hoped, make apparent son few directions in which an improvement can be made in wheat cultu as they have already shown the miller the quality of the grain fro various parts of the country.

OATS.

Oats are grown under as varied conditions as wheat, and are as a cr more variable in their appearance than any of the cereals. They can l made to pay on rich and poor soils of various descriptions, and althou flourishing in a cold climate, they can, in the form of certain rust-pr varieties, be successfully grown in the far South by sowing in the co part of the year.

In consequence of all the variations in the conditions of growth is a great variation in the weight of the grain, its plumpness and r tive proportion of kernel and husk or chaff, and in its other ph qualities. It is almost impossible to make a classification of the differe varieties, as they all shade gradually into each other. At extremes have the white potato oats of the North and the red rust-proof of South.

Among the most important characteristics of this grain, and one which it is most often judged by the farmer, is its weight per bush In close relation to this is the relation of kernel to husk, a point whi has been little, if at all, investigated.

One hundred and sixty-six specimens, collected from the most pr regions where oats are grown, these characteristics have be ured with the purpose of studying their relations, not only ment the chemical composition of the grain.

ce the amount of meal obtained from the best varieties does
ou 50 per cent. Our results show that the kernel stands to the
n the average, in the proportion of 7 to 3 for all parts of the coun-
se from the Western States being a little less husky. As ex-
are found among the averages for the different States—76.1 per
kernel in Washington Territory, and 61.17 for Utah, one sample
'ashington Territory having 79.28 per cent., and one from Dakota
.37. The extremes in weight per bushel, as indicated by the
s received, are 29.5 in Connecticut, and 48.8 and 48.6 in Colorado
kota respectively. The average weight for the whole country is
8.0 for the Northern States, 34.5 for the Southern, and 43.2 for
cific slope. The specimens are probably, many of them, above
rage, owing to the fact already mentioned that correspondents,
ciously perhaps, select samples which are not fair representatives
to the Department. Among themselves, however, the results
y bear comparison.

warm climate of the South lowers the average per bushel 2.7
, and diminishes the yield per acre from 30 bushels, often raised
North, to about 10. The relative proportion of kernel is not pro-
ely affected, the average being but 1.62 per cent. more of husk
tne North. This result is rather surprising, but is deduced from
mination of 90 specimens of Northern oats and 66 of Southern.
the white oats will grow they are generally heavier than others
ve a larger proportion of kernel.

Southern oats are above the average weight per hundred grains
whole country and for the North, being above the average in
Following are the figures:

Weight of oats per hundred grains and per bushel.

	Weight of 100 grains.	Weight per bushel.
	Grams.	*Pounds.*
es	2.507	37.2
tates	2.290	38.0
States	2.628	34.2
pe	2.737	43.2

looseness of the husk and its additional size are the occasion of
aller weight per bushel of the Southern grain, while the well-filled
f the Pacific coast furnishes the heaviest oats we have. Colorado,
stinguishes itself by samples, three in number, grown by Professor
averaging 43 pounds.

ir chemical composition the samples proved rather surprising.
reasonable to suppose that, as they are so susceptible of dete-
on and sensitive to the influence of their environment, great va-
would be found in their composition under different climatic
, as is the case with wheats. As will be seen this has not
to be so.

gh oats are fed in the husk to stock, it was thought best, for
of comparison with wheat and corn, to analyze the kernel sep-
In this way it is possible to compare the different specimens
tly of the proportion of husk which they possess, and then,
from the separate analyses the composition of the entire
be calculated.

Mr. Brewer, in his report on the cereals in the last census, r upon the indefinite knowledge which we have of the composition o grown under varied conditions and the necessity of a hundred o analyses for an intelligent understanding of the effects of enviro on the plant. Of the samples which we have collected, 179 have analyzed without finding any marked peculiarities due to climatic ditions, with the exception that the average of 18 samples from th cific slope was lower in albuminoids and richer in fiber than the ave for other parts of the country. The hulls from the West contain ash than those from the East and more fiber, but are not markedly ferent in other ways, although, like the kernels, they are somew ficient in albuminoids. As a whole this grain is the richest in o albuminoids of all the cereals.

Average composition of oats.

	Kernels.	H
	Per cent.	*Pe*
Albuminoids	14.31	
Fiber	1.88	
Oil	8.14	
Ash	2.15	
Water	6.93	

* Not determined.

The average of albuminoids for the different States varied from for Ohio to 10.76 for Washington Territory, the latter locality sustai its reputation, gained with wheat, for poverty in nitrogen.

The extremes in composition were as follows:

Extremes in the composition of the kernels of oats.

	Highest.	State.	Lowest.	State.
	Per cent.		*Per cent.*	
Water	11.13	Montana	4.67	Arkansas.
Ash	2.94	Michigan	0.87	Iowa.
Oil	11.20	Texas	6.50	Virginia.
Carbohydrates	71.91	North Carolina	62.82	Texas and Miss
Crude fiber	2.08	Kentucky and Oregon	0.88	South Carolina.
Albuminoids	19.44	Ohio	9.10	North Carolina.

The highest percentage of albuminoids in the preceding figur over 1 per cent. higher than in any other determination ever mad any cereal in this country, and the lowest is 2 per cent. higher tha lowest for wheat. It is also interesting to observe that among so specimens, one hundred and seventy-nine, only three fell below 1 cent., four below 11 per cent. and twelve below 12 per cent. A ame time only thirteen are above 17 per cent. and twenty-three a 16; so of one hundred and seventy-nine specimens all but twenty-e or 84.4 per cent., are within the limits of 12 and 16 per cent., a r small variation, and as the averages for all the States and parts o ountry, except the Pacific coast, do not vary far from 14.3 per ats, as regards chemical composition, cannot be said to be very ptible to the influence of their environment.

The chief quality to judge oats by, therefore, is their weigh ushel, which is an index of the proportion of kernel to husk, an

r has only to turn his attention to the selection of the variety giv- largest yield and weight per bushel.

As to the deterioration of seed brought from the North to the South, r analyses fail to furnish as much information as might be expected. he averages for these two sections of the country are so nearly the that no conclusions can be drawn from them. In the same way difference is found in the composition of heavy and light oats, nough light oats being more husky probably contain absolutely less lbuminoids.

It must here be remarked that in the last census year over one-half he crop of this cereal came from the five States, Illinois, Iowa, New fork, Pennsylvania and Wisconsin. The composition of our market ble crop is, therefore, nearly the average for these States.

BARLEY.

Although the production of barley in the United States has hitherto en small and insufficient to supply the demand, and although it is ined to a small portion of the country, it is growing, and, owing to he increased production of beer causing an increased demand, it ought o prove a profitable crop to cultivate and its area should increase. It oats no more than wheat to cultivate, it returns a greater number of ushels to the acre, and it is worth more per bushel.

Owing to its peculiar uses, a study of its chemical composition is of l interest, as, for malting purposes, aside from its color and to germinate, the relation of the starch to the albuminoids is greatest importance.

les have been collected, through our agents, to the number of t sixty, from those parts of the country where it is a crop of any ence. They represent fairly well the production of the United but Canada, which furnishes us with a large portion of what we s, unfortunately, not represented. The largest number of analy- not for the largest areas of production—New York, Wisconsin, alifornia, which raise more than half the crop—but they are scat- through all the States where any amount of barley is grown. In ring the average features of the crop as it is found in market, al regard must be had for the figures from the States just named, for the fact that Canadian barley, which is said to be the best, is not nted at all.

As it is almost impossible to detach the hulls from this grain, the majority were analyzed as they were threshed out and only a few separated into hulls and kernel.

average composition of the sixty unhulled specimens was:

	Per cent.
Water	6.53
Ash	2.89
Oil	2.68
Carbohydrates	72.77
Crude fiber	3.80
Albuminoids	11.33

hese figures the averages for the different portions of the coun- but little, although the Pacific slope, as usual, is 1 per cent. inoids than the Atlantic States, and somewhat heavier.

The large size and low percentage of albuminoids of the C barleys ought to make them valuable for malting purposes, c germinative properties being good.

Among the samples are barleys with the following extremes:

Extremes in composition in American barleys.

	Highest.	State.	Lowest.	Stat
	Per cent.		*Per cent.*	
Water	9.15	Minnesota	4.53	California.
Ash	4.43	California	1.50	Minnesota.
Oil	3.54	Indiana	2.06	Oregon.
Carbohydrates	76.79	Montana	68.99	Colorado.
Crude fiber	4.65	Ohio	2.64	Illinois.
Albuminoids	14.88	Dakota	8.75	Kentucky an

Dakota sustains its reputation for a high percentage of nitro Oregon for a low one, but the variations in this constituent as are not extreme. Barley, in fact, has a wide range of climate i it flourishes, and with rye shows a smaller variation in its com as influenced by climate than the other cereals.

The analyses which have been hitherto published do not diff rially from ours. Brewer gives nine in the last census and seve appeared in one of the recent numbers of Biedermann's *Cen für Agrikulturchemie*, 1884, p. 49. Koenig gives in his colle food analyses the following average of one hundred and twen specimens:

	Per cent.
Water	13.77
Oil	2.16
Ash	2.69
Carbohydrates	64.93
Crude fiber	5.31
Albuminoids	11.14

This makes the continental more fibrous than ours, and, as i ally the case with all their agricultural products, moister. Th ences are in favor of the American grain.

A few of the samples which were hulled or were naturally were analyzed, and their average composition was as follows:

	Per cent.
Water	6.26
Ash	2.18
Oil	2.66
Carbohydrates	75.53
Crude fiber	1.60
Albuminoids	11.77

The difference between these samples and the unhulled lies in of fiber and ash and the relative increase of the other constitu would be expected.

From a physical point of view there must be taken into consi the color and brightness of the grain, its perfection (that is, a sprout), its homogeneity, and its size and weight per bushel. considered only the weight and size as the other qualities are

by the practical man. The averages for the country are as

	No. of sample.	Weight of 100 grains.	Weight per bushel.
		Grams.	*Pounds.*
tes	76	3.4820	54.0
States	62	3.2585	53.4
ates	13	3.0162	52.6
tates	39	3.1712	52.8
ern States	10	3.6800	57.2
pe	12	4.6550	56.8

pecimens from the Northwest and the Pacific are heavier per ndred grains and in weight per bushel than the others, while rom the northern boundary are next in order. The heaviest per bushel is from Utah, 60.2 pounds, and the largest size, 4.9000 per 100 grains, from California. The lightest barley is from lvania, 50.4 pounds per bushel, and the smallest size, 2.6300 per 100 grains, is from the same State. Several of the bald va- run, of course, above the figures given, one from Washington y weighing 65.8 pounds per bushel and 4.9300 grams per 100

e few samples in which the husk was detached from the grain, ound to amount to about 15 per cent. on the average, with ex- of 16.94 and 12.55 per cents.

olor and consistency, together with the high nitrogen of our bar- wever, appear to be their weak points. From some recent Ger- periments we learn that a high-grade barley contains less than nt. of albuminoids, is mealy in consistency, in distinction from y fracture, and is necessarily of a clear white color. Many of leys are off-color, and but three of all our samples can be quali- mealy. The albuminoids are no higher than the averages of vestigators, but much higher than is allowable in good malting, ng to the best judges to-day. There seems to be much room, e, for improvement in the quality of this crop as grown among ell as in an extension of its area, so that we may produce our pply.

seems to be no reason why the desired result should not be ac- hed by careful selection and cultivation without nitrogenous s which tend to increase the percentage of albuminoids.

ntended to learn the views of practical malsters and brewers on ject and combine their conclusions with our results in our de- port.

RYE.

s cereal, which is of the least importance of any grown in the States, only five samples have been analyzed up to the present o pply this deficiency specimens were collected from the De- c espondents and the principal rye-producing States at the with oats and barley.

ve been examined physically and chemically, with the fol- :

specimen was from Washington Territory, weighing 3.450 grains, the next from Minnesota, weighing 2.780 per 100 heaviest weight per bushel from Vermont, 64.1 pounds.

The smallest were from Iowa and Nebraska, weighing 1.300 grams hundred grains, and the lightest from New York, 56.2 pounds per bu the average for the country being 2.074 grams per 100 grains and pounds per bushel. The largest and heaviest rye was found on Atlantic coast and in the Northern States. The Pacific slope was well represented.

The average weight per bushel is much higher than is usuall cepted for rye, but the specimens in hand certainly reached thos ures, either from being very clean or selected samples above the ave production. Illinois, which in the last census year produced mo the crop than any State except New York, sends the smallest and l est average grain.

In chemical composition the following extremes were found:

	Highest.	State.	Lowest.	State.
	Per cent.		*Per cent.*	
Water	10.00	Wisconsin	7.00	Washington Ter
Ash	3.72	Illinois	1.31	Nebraska.
Oil	2.91	Colorado	1.38	Wisconsin.
Carbohydrates	77.54	Nebraska	68.74	Colorado.
Crude fiber	1.90	Minnesota	1.10	Illinois.
Albuminoids	15.58	Colorado	8.75	Indiana.

But five were below 10 per cent. of albuminoids, and all but four below 13 per cent.

The grain cannot be said to be extremely variable. The averag the country is here given, together with an average of forty-nine a ses of ryes from all sources, given by Koenig:

	United States.	K
Water	8.67	
Ash	2.09	
Oil	1.94	
Carbohydrates	74.52	
Crude fiber	1.46	
Albuminoids	11.32	

The extremes of albuminoids in Koenig's analyses were 16.93 and per cent., which is wider than among our specimens.

For different parts of the United States the averages are very n concordant, the only variation being an average of half a per cen buminoids, and a little more fiber in ten specimens from the S The difference between our grain and that of the Continent appea the greater moisture of the latter, as is to be expected, together nore ash and oil and less fiber. The nitrogenous constituents are ically the same, and this cereal is richer than corn in this element ot so rich as wheat.

Rye cannot be considered as being very susceptible to climatic c ions; in fact it will flourish where other cereals will not. It req herefore, no greater care in its improvement than the selection o riety giving the largest yield and careful cultivation.

CONCLUSIONS ON THE CEREALS.

From our study of the various cereals, corn, wheat, oats, barley appears that they all have certain peculiarities, as shown by

properties and chemical composition. Of all, wheat is the most
uble to its environment, both chemically and physically; oats is
ely liable to deteriorate physically, but is not so changeable in its
sition; corn is much influenced in size and yield by climate, but
in quality, while rye is about the same thing wherever it is
and barley is produced in such a limited field that the effect of
nment is not marked.
Pacific coast and Colorado have a decided effect on all cereals.
a and Washington Territory produce them all, with lack of an
e amount of nitrogen, while the California grain varies in other
ts also, and is much drier than Eastern crops. All our grain, and
all our agricultural field products, are much drier, owing to our
e, than those of Europe, and this is an important factor in the
of bargain and sale. The Colorado cereals are all distinguished
r remarkable size and excellent development. They illustrate
be done on a rich soil and with careful cultivation in the pro-
of cereals.

DATA.

data from which the preceding conclusions are drawn are too
n number to be given in the present report. They will probably
anged and published as a special bulletin of the chemical di-
. The abstract, however, which has been given, contains the
l conclusions which can be derived from them.

SOIL ANALYSES.

numerous inquiries received at this office relating to the methods
ject of soil analysis have led me to believe that an abstract of the
t knowledge possessed by scientists on this subject would prove
rest to those engaged in scientific agriculture.
true that a knowledge of the chemical composition of the soil is
any means all that is necessary to judge of the proper method of
e or the extent of its fertility. Yet it must be admitted that
knowledge is a most valuable guide to the agriculturist in respect
kind of crop which is to be produced and the character of fertilizer
mployed. The chemical composition of the soil, when taken in
tion with its physical state and the climatic conditions of the
y, is a guide to scientific agriculture which cannot be neglected.
e a number of samples of soil from different parts of the country
accumulated in the laboratory, I requested Mr. Edgar Richards
duct the analyses and to collect the information which is hereby
tted. The analyst who desires information concerning the com-
n of soils will find something of value in this work, while the
who is not a chemist will discover in it a fund of information
soils and their proper treatment.

ON THE DERIVATION AND FORMATION OF SOIL.

ls are the results of the natural disintegration of the rocks by
e encies, mingled with decayed vegetable and animal mat-
or less proportion. If natural agencies, such as glaciers,
wind, &c., did not come into play and wash and transport
s of soil to a greater or less distance from their sources, the
locality would be simply the decayed upper surface of the

underlying rocks. But in proportion to the slope of the ground an the activity of the agents above mentioned the soil is transported fro higher to lower levels, and in many cases a good soil may be found co ering rocks which of themselves would only yield a poor soil.

COMPOSITION OF THE SOIL.

Soil is a mixture of sand, either quartzose or feldspathic, clay, carbo ate of lime, and humus or organic matter, and on the preponde one or more of these constituents the usual classification of based.

GENERAL CLASSIFICATION OF SOILS.

Soils are usually classified as sandy, sandy or light loams, l clayey loams, heavy or retentive clays, marls, calcareous loams, and p soils. This classification has reference chiefly to composition and te ure, a special chemical composition, silicious, calcareous, &c., b necessary for the profitable growth of particular crops, and a ce mechanical texture, friable, porous, &c., suiting best for the perm of rain and air, and the spreading of the roots of the plants.

Loams, which may be considered as typical soils, are a mixture sand, clay, and humus, which are spoken of as *light* when the sand p dominates and as *heavy* when the clay is in excess. These terms, *l* and *heavy*, do not refer to the actual weight of the soil, but to its te ity and degree of resistance it offers to the implements used in cultu tion. Sandy soils are, in the farmer's sense of the word, the lightest all soils, because they are the easiest to work, whilst in actual weig they are the heaviest soils known. Clay, though hard to work count of its tenacity, is comparatively a light soil in weight. r soils are light in both senses of the word, being loose or porous and ing little actual weight. (See Table III.)

GEOLOGICAL CLASSIFICATION OF SOILS.

Whatever their composition and texture, soils are, from a geologi standpoint, mainly of two sorts, soils of disintegration and soils transport. Under the former are comprehended such as arise from t waste and decay of the immediately underlying rocks, the limeston traps, granites, and the like, together with a certain admixture of ve table and animal débris; and which are directly influenced in composition, texture, and drainage by the nature of the subjacent ro from which they are derived. Under the latter are embraced all di and alluvial materials, such as sand, shingly débris, miscellaneous and clay, which have been worn from other rocks by atmospheric cies and transported to their existing positions by winds, waters, or ient glacier actions.

DIFFERENCE BETWEEN THE SOIL AND THE SUBSOIL.

Besides the *soils* proper, which come immediately under cultivati ere are in most places a set of *subsoils*, differing from the true so nd which cannot be ignored. The true soils are usually of a dar olor, from the large admixture of humus, whilst the subsoils are ligh hue, yellow, red, or bluish, from the great preponderance of the i xides. The soils are more or less friable in their texture, whilst subsoils are tougher, more compact, and more largely commingled w ubbly and stony débris. The soils are usually a little more than m surface covering, whilst the subsoils may be many feet in thickness.

THE ROCKS AND FORMATION OF THE SOIL.

reak up in course of time under the continued ac-
gencies, however hard and refractory they may be;
h chemically and mechanically. The rain, owing
arbonic acid from the atmosphere, acts chemically
lvent action, and also from its oxygen combining
et fully oxidized. Its mechanical action appears
he finer portions of the disintegrated rock or soil
ground. The changes in temperature have a loos-
ising alternate expansion and contraction. The
chemically upon the rocks by the slow oxidation
h can absorb more oxygen, and the production of
onates whose solubility still further aids disinte-
tegrating agencies are still further aided by the
s, by the burrowing of worms and other earth-
d in no small degree by the generation of organic
c., by organic decay. From the hardest granites,
he softest limestones and marls, all are undergo-
; and the soils to which they give rise will vary
, and texture, according to the softness and min-
ocks and the length of time they have been sub-
s.

n the solid rocks disintegrate even in countries
and where there is no frost. De Koninck, a Bel-
inion that such disintegration may be attributed
tric acids, together with the nitrates of ammonia,
the dew.*

ather most easily and rapidly do not always ex-
ften the reverse. A pure limestone would hardly
band or soil, because the carbonic acid of the rain
dissolve and remove the particles it acts upon.
neous rocks, their composition may be such that
the most rapidly would likewise show little of a
g to the same solvent action.

Y THE DIFFERENT GEOLOGICAL FORMATIONS.

feldspar is one of the constituents, are the origins
h which are met with in all arable soils; feldspar
um and potassium, which on disintegration forms
minium, and a silicate of potassium.

igneous rocks yield soils rich in potash, and the
se rich in phosphoric acid.

E DENUDATION OF THE SOIL.

which form the soils are also wasting and carrying
every rain storm transportation of soil goes on, as
show, after heavy, long-continued rains, by the
their waters, that they are carrying a vast quan-
ds the sea. The running streams bear along the
d gradually deposit it as the current diminishes
inest particles being carried as long as the stream

getable Mold and Earth Worms, 1882, p. 235.

remains in motion. When a river reaches a flat or level tract and over which its waters can flow in flood with a slow motion, the suspended matter, consisting principally of sand and mud, is deposited, and constitutes the *alluvium*, or new land, formed by such deposits at the river's mouth or along its banks.

THE QUANTITY OF SOIL SWEPT AWAY BY THE RAIN REPLACED BY THE DECOMPOSITION OF THE ROCKS.

Though the soil is thus continuously washed away, still it remains nearly constant in quantity, since what is taken away by denudation is made up from other causes, and this augmentation can proceed evidently from nothing but the slow and constant disintegration of the underlying rocks. The subsoils are likewise gradually being converted into soil and thus keep up the supply available for the nourishment of plant-life. The constant tillage and plowing of the ground subjects it more readily to the weathering action than is the case with grass or other lands protected by natural vegetation.

THE GENERAL FERTILITY OF THE SOILS DEPENDS PRINCIPALLY ON THEIR TEXTURE.

From an agricultural standpoint, the soil, which is the natural storehouse and laboratory whence plants derive their supply of food, should present different qualities which, according as they are more or less developed, exert a considerable influence upon its fertility; it should be firm enough to afford a proper degree of support for the plants that grow on it, and yet loose enough to allow the delicate fibers of the rootlets to extend themselves in all directions in search of the food of which they are in need. It must be of such a texture as to allow the free access of air, without which plants cannot live; and it must be retentive enough to retain, for a considerable time, the water which falls on it, and yet porous enough to allow the excess to drain away. In this respect, the nature of the subsoil and the depth of the surface soil are both important. When a soil rests immediately upon a bed of rocks or gravel, it will naturally be dryer than when it rests on clay or marl. On the other hand, a clay subsoil may be of great advantage to a sandy soil, by enabling it to retain moisture longer in dry weather. These qualities depend altogether on the state of division of the soil and its geological origin, and it is important, consequently, to study the arable soil under the two standpoints of its physical properties and of its chemical nature.

THE PHYSICAL PROPERTIES OF SOILS.

The physical properties of a soil may be considered in regard to its texture, its absorbent powers, and its temperature.

Soils differ not only in chemical composition, but also in physical characteristics, the aspect, elevation, depth, climatic conditions, drainage, &c., that enter into the problem and cause the variations in the relative productiveness of two fields.

The knowledge of the inherent agricultural capabilities of the different classes of soil is still very far from being perfect, though, by the researches of chemists since 1860, many important facts have been brought to light which have led to improvements in the cultivation of the land

IMPORTANCE OF A PROPER MECHANICAL CONDITION.

is not very difficult to adapt a plant or crop to the nature of the when once we know what mineral ingredients are required by the and furnished by the other; but it demands very close observation study and a most diligent application of means to bring the physi- r mechanical properties of the soil into the state best fitted for plant th.

nfluence of mechanical operations becomes obvious, as the access- y of air, moisture, and warmth, which are essential to the devel- ent of the changes that occur in the process of germination, are but tly influenced by the chemical composition of the soil, being all ndent on its mechanical condition. And this influence is not con- to the first stages of growth and development of vegetation, but quired all through the life of the plant, for they cannot avail them- s of their full amount of food unless the state of the soil admits of ree passage of air and moisture, and is favorable to the extension rootlets in all directions.

ATIONS IN THE TEXTURE OF SOILS INFLUENCE THEIR FERTILITY.

nay vary from the coarsest pebbles and loose sands to the finest st tenacious clays. Those soils are best adapted to agriculture n consist of a mixture of sand with a moderate quantity of clay a little vegetable matter. When the sand or other coarse material ominates, the soil is easy to till, and will grow most of the crops h are suitable to the locality; but it is deficient in the power of re- moisture and the soluble and volatile parts of manure. When ay is in excess, the soil is more difficult to till, and will probably fewer crops, as it retains more moisture, is not easily warmed, not admit of free access of air, and consequently does not facili- he chemical changes in the soil and manure placed on it which o important to the proper nourishment of the plants.

soils differed in nothing else than that of texture, the one which ined the greatest amount of finely divided matter would possess ntage over those with coarser parts. One cause of this supe- y consists in the greater absorptive and retentive powers which divided matter possesses, due probably to the immensely greater tity of surface exposed in a given bulk or weight of the more finely ed soil.

THE ABSORBENT AND RETENTIVE POWERS OF SOILS.

e observations of Sir H. S. Thompson * on the absorbent and re- ve powers of soil, or the power possessed by soil to decompose and for the subsistence of the plants the ammoniacal and other salts u form the most valuable constituents of manure, and the highly rtant investigations of Professors Way † and Voelckers on this sub- have had a most important bearing on practical agriculture, espe- y to the rational treatment and application of farm-yard manure and omical use of artificial manures.

nvestigations of Professor Way have given a new direction to study of soils, and the subject has been taken up by Liebig,

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*Jour. of the Royal Agricultural Society, vol. xi, p. 68. †*Ibid.*, p. 313.

Knopp, Henneberg, Stohman, Brustlein, Peters, Voelckers, War ton, and other chemists.

These several investigations have shown that the property of sorbing, retaining, and modifying the composition of manures belo to every soil in a greater or less degree.

ABSORPTION OF AMMONIACAL SALTS BY VARIOUS SOILS.

The ammonia floating in the atmosphere is continually being was into the soil carried into it by the rains. The clay, oxide of iron, the organic matter contained in the soils, perform the important fi tion of absorption. This property of clay may be one of the r why clay lands are more suitable to wheat than are sandy soils. though clay has this property of retaining more of these absorbed stances than sands or loams, yet it is evident that these latter soils n receive the same amount of fertilizing matter from the rains, only t have less ability for retaining or storing it up.

In regard to the absorption of ammonia and its salts by various s the following summary is taken from Dr. Voelckers' paper "On chemical properties of soils:"*

(1) All of the soils experimented upon had the power of absorbing ammonia its solution in water.

(2) Ammonia is never completely removed from its solution, however weak it be. On passing a solution of ammonia, whether weak or strong, through any ki soil, a certain quantity of ammonia invariably passes through. No soil has the p of fixing completely the ammonia with which it is brought in contact.

(3) The absolute quantity of ammonia which is absorbed by a soil is larger wl stronger solution of ammonia is passed through it, but relatively weaker solution more thoroughly exhausted than stronger ones.

(4) A soil which has absorbed as much ammonia as it will from a weak solu takes up a fresh quantity of ammonia when it is brought into contact with a str solution.

(5) In passing solutions of salts of ammonia through soils, the ammonia alone sorbed, and the acids pass through, generally, in combination with lime, or, lime is deficient in the soil, in combination with magnesia or other mineral base

(6) Soils absorb more ammonia from stronger than from weaker solutions of phate of ammonia, as of other ammonia salts.

(7) In no instance is the ammonia absorbed by soils from solutions of free or from salts of ammonia, so completely or permanently fixed as to prevent wa washing out appreciable quantities of ammonia.

(8) The proportion of ammonia which is removed in the several washings is in proportion to that retained by the soil.

(9) The power of soil to absorb ammonia from solutions of free or combined a is thus greater than the power of water to redissolve it.

It may be concluded from the above that in ordinary seasons no f need be entertained that occasional heavy rain storms will remove n ammonia from ammoniacal top-dressings, such as sulphate of amm soot, guano, and similar manures, but in excessively rainy seasons districts that have a large rainfall considerable quantities may b noved from land top-dressed with ammoniacal manures, even in the of stiff clay lands.

GENERAL CONCLUSIONS IN REGARD TO THESE POWERS.

The general conclusion that may be drawn from the different inv ations show that when the surface waters charged with the prod f vegetable decay are brought into contact with argillaceous sedi hey part to some extent with their potash, ammonia, silica, phospl

* Jour. Royal Agricultural Society, vol. xxi, p. 123.

l, organic matter, which remains in combination with the soil; under ordinary conditions at least, neither nitrates, soda, lime, e sulphuric acid, nor chlorine are retained. The phosphates pro ly retained in combination with alumina or peroxide of iron, d the silica and organic matters enter into more or less insoluble com- tions.

The drainage waters from clay soils, especially if the soil is in a fine ate of division, are found to carry off the nitrates, sulphates, chlorides, bonates of soda, lime, and magnesia.

THE POWER OF RETAINING MOISTURE IN THE SOIL.

The amount of moisture retained by a soil is generally in direct ratio o its contents of organic matter and its state of division. A proper de- ree of fineness in the particles of the soil is very important to obtain, specially if it is subjected to drought. During dry weather plants re- uire a soil that is both retentive and absorptive of atmospheric mois- ure, and that soil which has this faculty will evidently raise a more igorous growth than one without it. The materials which are most in- uential in soils may be arranged in the following order, when this con- ition of retaining moisture is considered: Organic matter, marls, clays, oams, and sands.

THE TEMPERATURE OF THE SOIL.

The temperature of a soil depends very much upon its humidity, ry lands absorbing more quickly and losing more slowly the heat han wet lands. The temperature of drained lands is consequently igher in summer than those which are undrained. The greatest dif- erence occurs in the spring between the temperature of the atmosphere nd that of the soil, as owing to the moisture from the winter and ng storms the soil, in consequence of the evaporation required to it sufficiently but gradually, acquires the proper temperature de- by the coming vegetation. After it is once thoroughly warmed ains a certain amount in reserve which is of benefit to the late g and gathering of certain crops. Dark-colored soils absorb re rapidly than those of lighter color.

FERTILITY OF THE SOIL DEPENDS ON CLIMATIC CONDITIONS.

In this country the soils are fertile enough, for the most part, to raise crop desired, if the climatic conditions are favorable, and this is a oint that must not be lost sight of. As it is certain that the range of he thermometer during the growing season of the year will affect the roductiveness of the ground, notwithstanding a favorable composi- ion and texture of the soil and an adequate rainfall, and disregard of local conditions as temperature, rainfall, elevation above sea- evel, aspect, nearness to water, &c., will lead to very erroneous opin- f the soil. Thus, in the case of the Northwest, for example, with severe winters and late springs and early falls, only such crops as ma ture early can be raised, notwithstanding the noted fertility of l.

amount of rainfall and the season of its descent determines the the crops raised, and exercises a considerable influence on ity of the soil. The action of the rain carries the soluble in- which the plants require to their roots and supplies them

with the necessary moisture. The soil, however, must be permeable enough to let the excess of water drain away; water-logged soils show immediate improvement when properly drained.

THE BARRENNESS OF SOIL.

No soil is absolutely barren, unless it contains substances poisonous to plants, such as an excess of organic acids, alkaline salts, the sulphate of iron, or the sulphide of iron or other injurious ingredients; but it may be so considered when it will not produce such crops as the farmer may wish to raise. Such a soil may, in many cases, be made productive by adding to it the constituent of which it is in need; but, if this cannot be done except at a prohibitory cost, or one at which more fertile ground can be procured, the soil may be regarded as practically worthless.

THE AVERAGE COMPOSITION OF ORDINARY FARM CROPS.

The amount of food taken from the soil by different crops is given in the following table taken from "The Chemistry of the Farm," pp. 38, 39. This table gives the average composition of ordinary farm crops, as grown in England, and the composition of the produce of beech, spruce fir, and Scotch pine forests felled for timber, and are the result of extensive investigations made in Bavaria.

The quantities of carbon, hydrogen, and oxygen present are omitted; also some of the smaller ash constituents. By "pure ash" is meant the ash minus sand, charcoal, and carbonic acid.

TABLE I.—*The weight and average composition of ordinary crops, in pounds, per acre (R. Warington).*

	Weight of crop—											
	At harvest.	Dry.	Total pure ash.	Nitrogen.	Sulphur.	Potash.	Soda.	Lime.	Magnesia.	Phosphoric acid.	Chlorine.	Silica.
	Lbs.	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
Wheat, grain (30 bushels)	1,800	1,530	31	33	2.7	9.7	0	1.0	3.7	14.3	.2	.5
Straw	3,158	2,653	158	12	5.1	18.2	2.5	9.2	4.0	8.4	1.7	110.6
Total crop	4,058	4,183	189	45	7.8	27.9	3.4	10.2	7.7	22.7	1.9	111.1
Barley, grain (40 bushels)	2,080	1,747	46	35	2.9	9.8	1.0	1.3	4.0	16.2	.4	12.6
Straw	2,447	2,080	100	12	3.2	21.6	4.2	8.5	2.5	4.4	3.2	51.3
Total crop	4,527	3,827	146	47	6.1	31.4	5.2	9.8	6.5	20.6	3.6	63.5
Oats, grain (45 bushels)	1,890	1,625	54	38	3.2	8.5	1.4	2.0	3.9	11.8	.	24.8
Straw	2,835	2,353	140	14	4.8	29.6	5.9	9.8	5.3	7.1	5.5	60.3
Total crop	4,725	3,978	104	52	8.0	38.1	7.3	11.8	9.2	18.9	5.5	94.1
Meadow hay (1½ tons*)	3,360	2,822	208	43	5.7	56.3	11.9	28.1	10.1	12.7	10.2	57.5
Red clover hay (2 tons*)	4,480	3,768	255	102	9.4	87.4	4.1	86.1	30.9	25.1	9.4	6.8
Peas, grain (30 bushels)	1,920	1,613	57	77	4.4	23.0	8	2.9	3.8	22.3	1.5	8
Straw	2,240	1,848	130	22	4.9	58.1	4.9	30.2	10.3	9.2	18.1	6.9
Total crop	4,160	[illegible]	187	99	9.3	81.1	[illegible]	33.1	14.1	31.5	19.6	7.7
Turnips, roots (17 tons*)	38,080	3,126	218	71	15.2	108.6	17.0	25.5	5.7	22.4	10.9	2.6
Leaf (17 tons*)	11,424	1,531	146	49	5.7	40.2	7.5	48.5	3.8	10.7	11.2	5.1
Total crop	49,504	4,657	364	120	20.9	148.8	24.5	74.0	9.5	33.1	22.1	7.[illegible]

* A ton of 2,240 pounds.

The weight and average composition of ordinary crops, &c.—Continued.

	Weight of crop. At harvest.	Weight of crop. Dry.	Total pure ash.	Nitrogen.	Sulphur.	Potash.	Soda.	Lime.	Magnesia.	Phosphoric acid.	Chlorine.	Silica.
	Lbs.	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
tons*).....	31,360	3,340	163	74	14 [illegible]	65.3	22.6	19.7	6.8	10.9	6.8	3.1
.....	4,704	706	75	28	3.2	16.4	9.2	22.7	2.4	4.8	8.8	3.6
.....	36,064	4,055	238	102	17.8†	79.7	32.0	42.4	9.2	21.7	15.1	6.7
tons*) ..	4[illegible],280	[illegible]	41[illegible]	96	4.9	101.1	75.4	24.2	19.7	34.0	40.6	16.4
.....	18,233	1,654	280	51	9.1	71.4	65.2	29.1	27.2	15.1	49.8	9.2
.....	67,513	7,282	690	147	14.0	262.5	140.6	53.3	46.9	49.1	90.4	25.6
6 tons)* ..	13,440	3,360	126	47	2.7	75.4	2.0	2.9	5.7	24.1	3.5	2.9
.....	4,274	954	50	20	2.1	1.1	2.0	22.7	12.4	2.7	1.9	2.1
.....	17,714	4,314	176	67	4.8	76.5	4.0	25.6	18.1	26.8	5.4	5.0
.....	.....	2,82[illegible]	26	.		4.2	.8	12.9	3.4	2.6	...	2.2
.....	.....	2,973	100			8.8	1.6	73.1	10.0	9.3	..	53.9
ice	.....	5,797	192	..	..	13.0	2.4	86.0	14.3	11.9	....	56.1
.....	.....	3,064	20	..	.....	3.6	.4	8.2	1.8	1.3	...	2.9
.....		2,683	121		..	4.3	1.5	54.4	6.2	5.7	...	44.3
ice	.	5,747	141	.		7.9	1.9	62.6	8.0	7.0	.	47.2
d	.....	2,884	15	..	..	2.3	.2	9.0	1.5	1.0	....	.5
.....	.....	2,845	42	..	..	4.3	1.7	16.8	4.3	3.3	.....	5.8
ice	.....	5,729	57	....	..	6.6	1.9	25.8	5.8	4.8	.....	6.3

on of 2,240 pounds. †Calculated from a single analysis only.

above table we can judge of the quantity of the different ents which various crops absorb from an acre of ground, rtain plants demand some one particular ingredient more

In general, we may say that the cereal crops apparently pacity for feeding on silicates not enjoyed by other crops, a less amount of nitrogen than either the root or legumi- nevertheless they respond the most readily to nitrogenous The amount of phosphoric acid is the most constant of all ient of crops, being concentrated in the grain. The root n a large amount of potash, and are the most exhausting n consequence; they take up more nitrogen than do the ides other ash constituents, as phosphoric acid. Legumi- contain about twice as much nitrogen as do the cereals, and and lime occurs in large proportions. Silica is nearly absent. d most readily to potash manures.

th of forests is far less exhausting to a soil than are most m crops, especially where the leaves from the trees are left he ground by their decay.

PERMANENT FERTILITY.

igations of Messrs. Lawes and Gilbert in regard to the ex- and by the same crops grown year after year on the same nured, which they have been carrying on at Rothamsted, the past forty years, leads them to conclude that all lands for a longer or shorter number of years have a certain

standard of natural fertility, varying within certain limits, according to the character of the season and the management; which standard, on a large scale, could practically neither be permanently reduced nor increased by cultivation. Such lands are said to be "out of condition."

Of course it must be borne in mind that these observations apply to actual English farm practice, and the term must not be pushed to any great extreme.

ACQUIRED OR TEMPORARY FERTILITY.

A land is said to be "in good condition" when by the application of manure its permanent fertility is raised so as to produce larger crops, due to the accumulation within the soil of suitable plant-food derived from the manure, which may be reduced or entirely withdrawn by the crops. But since it is the minimum of any one essential ingredient and not the maximum of the others which is the measure of fertility, a soil may become exhausted for one plant yet still contain an abundant food-supply for another plant whose food requirements are different. Thus a rotation of crops will defer the period of exhaustion. A poor soil is sooner reduced to sterility than a rich one, a shallow soil would fail sooner than a deep one, and a light soil sooner than a stiff one. As only about 1 per cent. of a soil is in a fit condition at any moment for plant-food, an immense store of nourishment is contained in most soils in a passive condition, which gradually becomes available.

IMPROVEMENT OF THE SOIL.

The improvement of the soil by tillage, drainage, irrigation, liming, and the application of manures does not enter into the subject of this report, and the reader in quest of such information is referred to any of the standard works on agriculture, where these subjects are treated in full detail.

THE MECHANICAL ANALYSIS OF SOIL.

At one time great stress was laid upon the mechanical analysis of a soil, and chemists were told that more depended on it than on the chemical composition, but nowadays, whilst a knowledge of its physical condition is a great help in studying the nature of a soil, still its chemical analysis is of more importance.

Of the great number of apparatus proposed to effect the mechanical analysis of soils, all labor under more or less objections, and the same soil submitted to different processes yields most diverse results.

An Italian chemist, M. Pellegrini, obtained the following results with a clay soil of Orciano, near Pisa, on using the apparatus named (Peligot, Traité de Chimie Analytique appliquée a L'Agriculture, 1883, p. 154):

	Noeble's.	Schloesing's.	Masure's.
Sand	1.47	32.07	13.35
Clay	87.31	37.67	71.90
Earthy carbonates	.....	20.20	.....
Organic and volatile matter	9.66	10.25	.....
Undetermined	.....	.....	14.75
Soluble and loss	1.56	.....	.....
	100.00	100.19	100.00

these differences are enormous, still the methods are hardly able. That of Schloesing's has for its object the separation of clay in almost a pure state from the sand, lime, and other materials which accompany it. Masure's and Noeble's apparatus make use of the mechanical action of a stream of water to separate the soil into more or fine particles.

OBJECTION TO THE MECHANICAL ANALYSIS OF A SOIL.

The objection most frequently urged against such mechanical analysis that the lightest portion, most commonly called clay, contains, addition to that body, some very fine sand, some calcareous or feldthic products, in addition to organic matter in a fine state of division. cause of error has long been pointed out by Boussingault, Gasparin, other authors.

PRINCIPLE APPLIED TO MOST OF THE APPARATUS USED FOR THIS PURPOSE.

principle adopted in most apparatus used for this purpose is the action of a stream of water flowing through the soil into a on of vessels, each somewhat larger than the one preceding, and men a certain amount of sediment is gradually deposited, beginning the coarsest and heaviest particles and ending with the very finest. hed quantity of the air-dried soil is taken, and the action of the continued until it runs through the last vessel used perfectly r; the different deposits are collected, dried, ignited, and weighed tely. The results obtained are only approximate, and differ in the l using the same apparatus.

succ on of metal sieves, ranging from ten to one hundred meshes e inch, are sometimes used for this purpose, a weighed quan- of being taken and the portion remaining on each sieve being and weighed.

THE EFFECT OF VARIOUS PROPORTIONS OF SAND IN THE SOIL.

According to Thaer (Peligot, p. 158), when the sand and clay are of parts, or in the proportion of 40 of sand to 60 of clay, comprising this name the finest sand, &c., as found in mechanical analysis, is fitted for all kinds of crops; with more than 60 per cent. of ney are suitable to rye and barley, rarely for wheat; with 70 per of sand the soil is suitable still for the cultivation of barley, and cially for the cultivation of rye; it is easily worked, but manures apidly used up. With 90 per cent. of sand the soil becomes dusty ry weather, and it becomes difficult to reap any benefit from it. less than 30 per cent. of sand, the very clayey soils are still fitted he cultivation of oats. When the proportion of sand is 30 per cent. ey raised is better than wheat.

THE CHEMICAL PROPERTIES OF SOIL.

knowledge of the chemical composition of a soil is often of great to the farmer, as allowing him to judge whether it contains the soil-constituents of which the crops he proposes to raise stands or, being deficient, what is likely to prove the best fertilizer to d. Mere analytical results do not, in a great many cases, show cultural capabilities of a soil; thus, there are many soils whose composition is apparently similar, that is to say, that the nu-

merical results obtained by analysis show the like quantities of silica, lime, magnesia, soda, potash, phosphoric acid, &c., and yet a certain crop—clover, for instance—will flourish on the one and not on the other. The physical nature of such soils, their depth, character of subsoil, aspect, texture, climatic conditions, &c., have likewise to be taken into account. Thus the many problems that enter into the study of soils are so various that chemical analysis alone does not afford, in most cases, a sufficient guide to an estimate to their agricultural capabilities, nor to point out the particular manure that is adapted for the special crops intended to be grown.

The most detailed chemical analysis usually gives only the proportion of the different constituents, and without any reference to the state of combination in which they exist in the soil or to their absorptive and retentive powers.

GREAT CARE NECESSARY IN OBTAINING THE SAMPLE FOR ANALYSIS.

On the care with which the soil is sampled of course depends the analytical results, and too much stress cannot be laid on the necessity that exists to obtain a fair average sample, representing as far as po both the good and bad qualities of the soil that is to be submit to analysis. As the chemical analysis of a soil is a very long, ted delicate operation, and the difference of a one-thousandth of 1 in any one constituent is equivalent to 20 or 30 pounds to the acre lost or gained in that element, the importance of the sample truly representing the soil is apparent.

THE CHEMICAL COMPOSITION OF SOILS.

Soil consists of an organic and of an inorganic or mineral part, the former derived from the decay of plant-life for many ages, together with the dung and remains of animals, and the latter arising from the weathering of the rocks.

The organic matter varies in different soils, being most defi t sandy soils and poor clays, and even in very fertile lands occurs only in small quantities. In the famous black soil of Russia, which found in the provinces of the Ural Mountains and in those that border them, it varies from 5 to 12 per cent. In some of our own prairie so the amount is nearly as high. In leaf mold it occurs conside y higher and in peat more than 50 per cent., very often. From its dark color it is a good absorbent of heat, its own specific heat being l above that of the soil generally. It is hygroscopic and greatly incr the water-holding power of sandy soils; besides, it has the power of absorbing and retaining ammoniacal salts. By its decomposition it forms a source of carbonic acid, which is readily absorbed by plant-life. The mechanical condition of a soil is much improved by its presence when in moderate quantities, but when present in excessive amount it acts injuriously by deoxidizing ferric salts and in other ways. (Versuchs Stationen Organ, vol. xiv, pp. 248–300.)

The inorganic or mineral portions of the soil is, with the addition of humina, composed of the same substances as make up the inorganic portion of plants, and which form their ashes when burnt. The min al soil-constituents include the following substances:

Silica, SiO_2
Alumina, Al_2O_3
Lime carbonate, $CaCO_3$
Ferric oxide, Fe_2O_3.
Phosphoric acid, P_2O_5
(Phosphoric anhydride.)
Potash, K_2O.
Soda, Na_2O.
Magnesia, MgO.
Chlorine, Cl.
Sulphuric acid, SO_3.
(Sulphuric anhydride.)

ist in very different proportions in different soils. The first
, clay, and lime, represent more than 90 per cent. of the sub-
ost soils, and as one or the other predominates the soil is said
ay, clayey, or calcareous. The most active constituents of the
phoric acid, and the two alkalies, potash and soda, occur in very
tities, as do the other and less important constituents, mag-
chlorine, and sulphuric acid.

exists in different proportions in the various soils, mostly in an
le state, and that most largely in the poorest sandy soils; fer-
ontain generally a very small quantity of it in a soluble form.
soils contain from 70 to 90 per cent. of silica; even stiff clay soils
0 to 70 per cent.; and calcareous or lime soils and marls from 20
cent.

its value, as a source of plant food, consists in being in the form of
luble silicates. In its insoluble state, like quartz sand, its action is
y mechanical, making the soil lighter for cultivation. Those soils,
from rocks of which feldspar is one of the constituents, will con-
ne silica in a soluble form, whilst those derived from quartzose
s will contain it in the insoluble state. The hydrated silica, in the
represents that which is gradually available for plant food.

, or clay, is a silicate of aluminium, and it is derived from
ration of feldspathic rocks and other similar silicates; if ab-
ly pure it would furnish nothing for plant food; as, however, this
seldom the case, it furnishes a supply of potash frequently in con-
able quantities. Clay has the important property of absorbing and
ining phosphoric acid, ammonia, potash, lime, and other substances
for plant food. Clay soils contain on an average from 6 to 10
. of alumina. In sandy soils it varies from 1 to 4 per cent., and
s, calcareous soils, and vegetable molds from 1 to 6 per cent.

The presence of alumina in the soil is purely mechanical, as it is never
nd in the mineral portions of plants, and the larger the percentage
it present the more difficult the soil becomes to cultivate, offering a
ter or less resistance to the implements of tillage.

The percentage of alumina as found by the method of chemical analy-
l is but an imperfect indication of the amount of *clay* in the soil.
unt of alumina continues to increase long after the rest of the
rtant substances have been dissolved if the digestion in hot dilute
be prolonged. If this was combined as a hydrous silicate the
t of hydrated silica found, by boiling the insoluble residue with
bonate, should bear a certain ratio to the alumina present.
however, is seldom the case.

rarely that the amount of silica dissolved satisfies the requirement for
g with the alumina into kaolinite, and in a *very* few cases there is an excess
over that requirement. In numerous cases the silica falls so far below the
corresponding to the alumina as to raise a serious question as to the combina-
n which the latter occurs in the soil, the *hydrate* (Gibbsite) being almost the
possible one, apart from zeolitic minerals. Perhaps this fact may serve to ex-
some of the otherwise incomprehensible variations in the physical properties of
hose chemical and mechanical analysis would seem to make them almost
In some of the Tertiary and prairie soils of the Southern States, more-
re seems to occur still another amorphous mineral, related to or identical
sponite, which sometimes occurs in segregated masses and imparts to these
ery peculiar and unwelcome properties in tillage. We are evidently, as yet,
from a full understanding of the mechanical constitution of soils. (E. W.
, Tenth Census, U. S.)

or calcareous matter generally occurring in the state of car-
es in soils from about 90 per cent. and under in limestones
to mere traces in some other soils. Clays and loams gener-

ally contain from 1 to 3 per cent. of the carbonate. Less than 1 cent. may be regarded as a defective quantity. In the lightest soils the percentage of lime should not fall below .100, in clay loa not below .250, and in heavy clay soils not below .500. Where a is deficient in lime, the little there is of it is present in combination wi the organic acids, and is more abundant on the surface than in the su soil. It preserves the particles of clay in a separate coagulated tion, and thus allows them to exercise their absorbent powers on vari salts, which otherwise would escape their action. It also promo decomposition of vegetable matter and the formation of nitrates in t soil.

Most green crops are often subject to disease when grown on soi deficient in lime, even when they have been well manured. Up to certain stage, the cereal or other crops appear to thrive well, but as t season advances they sustain a check and yield a poor harvest. Th is especially the case in poor sandy soils, and a good dose of lime marl, followed by barnyard manure or guano, has a most benefici effect. By this means the valuable portion of the manure or guano, t ammonia, potash, and phosphoric acid, are retained in the land, wh the others combine with the lime and are gradually washed out.

Ferric oxide is found in all soils, and causes the reddish color so ve common in a great many of them. To its presence is chiefly due t retention of the phosphoric acid, an insoluble basic phosphate of ir being produced. On its state of oxidation depends its favorable inf ence on the soil, that of ferric, sesqui or per oxide, better known as t red rust of iron, being the most suitable. In its less perfectly oxidiz forms, which are, however, soluble in organic acids that exist ve often in the subsoil, it becomes peroxidized on exposure to the air. I action is both physical and chemical. The preference of farmers f "red lands" arises from their experience of its beneficial action in t soil.

From 1.5 to 4 per cent. of ferric oxide is ordinarily found in soils slightly tinted. Ordinary ferruginous loams vary from 3.5 to 7 p cent., highly colored "red lands" have from 7 to 12 per cent., a occasionally 20 per cent. and more. The efficiency of the ferric oxi depends upon its mechanical condition; when incrusting the grains sand or occurring as nodules, whilst the chemical analysis may show large percentage of it present, it exerts little or no influence upon soil, but when in a state of fine division these advantages are reali

Soils containing a large percentage of ferric oxide have generally low percentage of organic matter, but, notwithstanding, are, as as a ru very fertile. In clay lands especially its presence is very beneficial tending to make them easier for tillage; its color tends to the abso tion of heat and of oxygen. Such soils, however, suffer from floods bad drainage, the ferric oxide becoming reduced under such circu stances to the ferrous state.

Phosphoric acid is contained in all good soils, but in very small qua ities when compared with the other principal ingredients, and exists combination with lime, iron, and alumina, phosphate of lime being most common form. In general, even in the most fertile soils, it is fou in very minute quantities, on an average less than a half per cent.; clay lands this may rise to 1 per cent. Its value in fertilizers depe on its state of combination, whether it is soluble and immediately avai ble for plant food as the superphosphates, or slowly soluble like the li phosphates, forming a reserve store of food for the future. It occ in all soils that have been formed from such rocks as the granit

gneisses, limestones, and dolomites, which contain it without exception; volcanic soils possess it in large quantities, whilst alluvial soils and those lands that are periodically swept by floods, are much poorer. Soils containing less than .05 per cent. of it will be sterile and unfertile, as a general rule, unless accompanied by a large amount of lime.

Potash.—All soils suitable for cultivation contain potash in an available form arising from the disintegration of feldspathic and other rocks. In the majority of cases the natural supply of the soil is sufficient to furnish to the plants the potash of which they are in need; a soil containing .125 per cent. should furnish potash enough for a century, without its being necessary to add to the manures used on such soils any salt of potash. Besides this available potash the soil often contains very considerable quantities of this element which the acids do not attack and which form the reserve for the future supply of the plants.

The quantity of potash varies in the different soils from the merest traces up to 1 and 2 per cent. Sandy and peaty soils and marls are generally deficient in this alkali, whilst soils rich in alumina are with some exceptions, also rich in potash. It exists in the soil in combination with silica, forming a silicate which is somewhat soluble in water. Heavy clay soils and clayey loams vary from .8 to .5 per cent.; lighter loams from .45 to .30 per cent.; sandy loams below .3 per cent., and sandy soils of great depth may contain less than .1 per cent. consistently with fertility, depending on the amounts of lime and phosphoric acid with which it is associated. A high percentage of potash in a soil seems capable of making up for a low percentage of lime, and, conversely, a soil very rich in lime and phosphoric acid may be very fertile notwithstanding a low percentage of potash. The average annual consumption of potash for raising crops is 45 pounds per acre, or about .002 per cent.

Soda.—This is a less important constituent in soil than potash, and unless near the sea coast is present in even smaller quantities. Under the form of common salt, however, its presence is a cause of sterility in the soil when it exceeds .10 per cent. in quantity.

Magnesia is found in all fertile soils, in different proportions, often amounting to a mere trace. In the majority of cases the percentage of magnesia is greater than that of the lime, but it does not seem capable of performing to any appreciable extent the general function of lime in soil improvement.

Sulphuric acid and chlorine occur very sparingly in most soils. From .02 to .04 per cent. of the former seems to be adequate to most soils.

There does not exist any affinity between the quantities of lime and magnesia contained in soils and those of potash and of phosphoric acid.

Nitrogen and nitrates.—The natural sources of nitrogen in crops are the nitrates and ammonia salts, which are seldom present in large quantities, and should be used on or generated in the soil as rapidly as crops require them. The process of nitrification, whereby inert or unassimi-

nitrogen becomes converted into nitric acid, is thus of great im-

ance to agriculturists. This is due to a minute *bactarium* present

al soils, whereby the humus and ammonia are oxidized and the nitro-

converted into nitric acid. This process does not take place unless

l is moist and has free access of air, and some base, generally

, is present with which the nitric acid can combine. Nitrification

most active in summer and ceases apparently in winter.

. Lawes and Gilbert have for some years past been devoting

ition to the sources of the nitrogen of crops, and in the pages

rnal of the Royal Agricultural Society and of the Journal of

Society will be found their reports in full.

The following is the summary and conclusions which they hav published in a long article on "Some points in the composition of in the June number of the Journal of the Chemical Society f s p. 420:

(1) The annual yield of nitrogen per acre in various crops, grown for many in succession on the same land without nitrogenous manure, was found to b much greater than the amount of combined nitrogen annually coming down and the minor measurable aqueous deposits.

(2) So far as the evidence at command enables us to judge, other supplies o bined nitrogen from the atmosphere, either to the soil or to the plant itself, ar inadequate to make up the deficiency.

(3) The experimental evidence as to whether plants assimilate the free nitr the atmosphere is very conflicting; but the balance is decidedly against the su tion that they so derive any portion of their nitrogen.

(4) When crops are grown year after year on the same land, for many years cession without nitrogenous manure, both the amount of produce per acre a amount of nitrogen in it, decline in a very marked degree. This is the cas when a full mineral manure is applied, and it is the case not only with cere with root crops, but also with *Leguminosæ*.

(5) Determinations of nitrogen in the soils show that, coincidentally with cline in the annual yield of nitrogen per acre of these very various descriptions of grown without nitrogenous manure, there is also a decline in the stock of nitr the soil. Thus a soil source, of at any rate some, of the nitrogen of the crop dicated. Other evidence pointed in the same direction.

(6) Determinations of the nitrogen as nitric acid, in soils of known histor manuring and cropping, and to a considerable depth, showed that the amount o gen in the soil in that form was much less after the growth of a crop than und responding conditions without a crop. This was the case not only with the g eous but with leguminous crops. It was hence concluded that nitrogen ha taken up as nitric acid by the growing crops.

(7) In the case of gramineous crop soils, the evidence pointed to the conc most, if not the whole, of the nitrogen of the crops was taken up as nitric the soil.

(8) In the experiments with leguminous crop soils, it was clear that some rate of the nitrogen had been taken up as nitric acid. In some cases the evide in favor of the supposition that the whole of the nitrogen had been so taken u others this seemed doubtful.

(9) Although in the growth of leguminous crops year after year on the san without nitrogenous manure, the crop, the yield of the nitrogen in it, and th nitrogen in the surface soil greatly declined, yet, on the substitution of anothe of the same family, with different root-habits and root-range, large crops, con large amounts of nitrogen, may be grown. Further, in the case of the occ growth of a leguminous crop, red clover for example, after a number of cer other crops manured in the ordinary way, not only may there be a very large of nitrogen in the crop, presumably derived from the subsoil, but the surface comes determinably richer in nitrogen, due to crop residue.

(10) It was found that, under otherwise parallel conditions, there was very more nitrogen as nitric acid, in soils and subsoils down to a depth of 108 inches leguminous than where gramineous crops had grown. The results pointed to t clusion that, under the influence of leguminous growth and crop-residue, the tions were more favorable for the development of the nitrifying organism an cially in the case of deep-rooting plants, of their distribution, thus favoring th fication of the nitrogen of the subsoil, which so becomes a source of the nitr such crops.

(11) An alternative was that the plants might take up at any rate part of th gen from the soil and subsoil as organic nitrogen. Direct experimental evidenc o the conclusion that fungi take up both organic nitrogen and organic carb here is at present no direct experimental evidence in favor of the view that caved plants take up either nitrogen or carbon in that form from the soil; here are physiological considerations which seem to militate against such a v

(12) In the case of plots where *Trifolium repens* [white clover] and *Vici* cares or vetches] had been sown, each for several years in succession, on which no nitrogenous manure had been applied for thirty years, and the sur d become very poor in nitrogen, both the soil and subsoil contained much le gen as nitric acid where good crops of *Vicia sativa* had grown than where shallow-rooted *Trifolium repens* had failed to grow; and the deficiency of ni ver in the soils and subsoils of the *Vicia sativa* plots, compared with the

Trifolium repens plots, was, to the depth examined, sufficient to account
proportion of the nitrogen of the *Vicia* crops.

be considered established that much, if not the whole, of the nitrogen
ved nitrogen within the soil—accumulated or supplied; and that much,
ases the whole, of the nitrogen so derived, is taken up as nitrates.

ination of a number of the United States and Canadian prairie soils
be very much richer in both nitrogen and carbon, to a considerable
the surface soils of old arable lands in Great Britain, and about as rich,
greater depth, as the surface soil of permanent pasture land.

exposure of portions of some of these rich prairie soils, under suitable con-
temperature and moisture, for specified periods, it was found that their
as readily susceptible of nitrification, and so of becoming easily available

several extractions, the subsoils almost ceased to give up nitric acid; but
them with a tenth of a gram of rich garden soil containing nitrifying or-
here was a marked increase in the rate of nitrification. This result af-
firmation of the view that the nitrogen of subsoils is subject to nitrifica-
der suitable conditions, and that the growth of deep-rooted plants may
fication in the lower layers.

ler favorable conditions of season and of cultivation, the rich prairie soils
crops; but, under the existing conditions of early settlement, they do not,
rage, yield crops at all commensurate with their richness, when compared
oils of Great Britain which have been under arable culture for centuries.
; as the land is cheap, and labor dear, some sacrifice of fertility is unavoid-
process of bringing these rich virgin soils under profitable cultivation.

omparison of the percentages of nitrogen and carbon in various soils of
tory, show that the characteristic of a rich virgin soil, or of a permanent
rface soil, was a relatively high percentage of nitrogen and carbon. On
and, soils which have long been under arable culture are much poorer in
cts; while arable soils under conditions of known agricultural exhaus-
a very low percentage of nitrogen and carbon, and a low proportion of car-
ogen.

only the facts adduced in this and in former papers, but the history of
throughout the world, so far as it is known, clearly shows that, pre-emi-
far as the nitrogen is concerned, a fertile soil is one which has accumulated
he residue of ages of natural vegetation, and that it becomes infertile as
is exhausted.

lowing table shows the character of exhausted arable soils,
laid down pasture lands, and of old pasture soils at Roth-
England; of some other old arable soils, of some Illinois and
prairie soils, and lastly, of some very rich Russian soils in re-
heir percentages of nitrogen and carbon, taken from the same
419:

TABLE II.—*Nitrogen and carbon in various soils.*

[In dry sifted soil, calculated on soil dried at 100° C.]

ROTHAMSTED ARABLE AND GRASS SOILS.

	Date of soil sampling.	Nitrogen.	Carbon.	Carbon to one nitrogen.	Authority.
		Per ct.	*Per ct.*	*Per cent.*	
3; barley, 1853–'55; roots, 1856–'69; nures	Apr., 1870	.0934	.....	.....	Rothamsted.
'44, and each year since; mineral	Oct., 1865	.1119	1.039	9.3	Do.
	Oct., 1881	.1012	1.079	10.7	Do.
and each year since; mineral man-	Mar., 1868	.1202	.....	.....	Do.
	Mar., 1882	.1124	1.154	10.3	Do.
own to grass:					
spring, 1879	Feb., 1882	.1235	.....	.....	Do.
spring, 1874	Feb., 1882	.1509	.....	.....	Do.
field, spring, 1863	Nov., 1881	.1740	.....	.....	Do.
dow, spring, 1858	Jan., 1879	.2057	2.412	11.7	Do.
(?) 1838	Sept., 1878	.1943	2.403	12.4	Do.
ure (the Park)	Feb. and Mar., 1876	.2466	3.377	13.7	Do.

TABLE II.—*Nitrogen and carbon in various soils*—Continued.

VARIOUS ARABLE SOILS IN GREAT BRITAIN.

	Date of soil sampling.	Nitrogen.	Carbon.	Carbon to one nitrogen.	Authority.
		Per ct.	*Per ct.*	*Per cent.*	
Mr. Prout's farm:					
Broadfield, surface		.170			Voelcker.
Blackacre, surface		.107			Do.
Whitemoor, surface		.171			Do.
Wheat soil:					
Midlothian		.220			Anderson.
Eastlothian		.130			Do.
Perthshire		.210			Do.
Berwickshire		.140			Do.
Red sandstone soil, England		.180			Voelcker.

UNITED STATES AND CANADIAN PRAIRIE SOILS.

Illinois, United States:					
No. 1		.300			Voelcker.
No. 2		.260			Do.
No. 3		.330			Do.
No. 4		.340			Do.
Portage la Prairie, Manitoba, surface		.247			Rothamsted.
Saskatchewan district, Northwest Territory, surface		.303			Do.
Forty miles from Fort Ellis, Northwest Territory, surface		.250			Do.
Niverville, Manitoba, first 12 inches		.261	3.42	13.1	Do.
Brandon, Manitoba, first 12 inches		.187	2.66	14.2	Do.
Selkirk, Manitoba, first 12 inches		.618	7.58	12.3	Do.
Winnipeg, Manitoba, first 12 inches		.428	5.21	12.2	Do.

RUSSIAN SOILS.

No. 1, 12 inches		.607			C. Schmidt.
No. 2, 8 inches		.467			Do.
No. 3, 5 inches		.188			Do.
No. 4, 6 inches		.130			Do.
No. 5, 11 inches		.305			Do.
No. 6, 17 inches		.281			Do.
No. 7, 9 inches		.409			Do.

FERTILITY DEPENDS ON THE MINIMUM QUANTITY OF ANY NE SARY CONSTITUENT PRESENT.

As the soil is the source whence plants derive their mineral all the elements required for this nourishment have, in a certain equal value, for if one of them is wanting in the soil, or is pre a form not readily available by the roots, the plant will not flourish and so its fertility depends on the minimum quantity of any necessary constitutent present.

WEIGHT OF A SOIL PER ACRE.

The weight of soil on an acre of land is so enormous that even small proportions of plant food may amount to every considerable quantity The weight varies with the porosity and the amount of sand and gravel the soil contains.

The following table gives the specific gravity, the weight of 1 cubic foot of different soils, dry and wet, taken from the table in Prof. Johnson's article "On the physical properties of soils," in the J

al Agricultural Society, vol. 1, p. 210, together with their ap-
weight per acre to a depth of 9 inches, equal to 32,670 cubic
ıs of 2,000 pounds.

-Table showing the specific gravity, the weight of one cubic foot of different soils, et, according to Schübler, and the approximate weight per acre to a depth of 9 670 cubic feet).

Kind of soil.	Specific gravity.	Weight 1 cubic foot.		Weight per acre 9 inches deep.	
		Dry, lbs.	*Wet, lbs.*	*Dry, tons.*	*Wet, tons.*
, occurring in almost every arable soil..	2.653	111.3	136.1	1,818.0	2,223.2
ıd, frequently occurring along with si-	2.722	113.6	141.3	1,855.6	2,308.1
combination of 45 per cent. of fine sand, cent. of clay	2.601	97.8	129.7	1,597.6	2,118.6
combination of 24 per cent. of fine sand, cent. of clay	2.581	88.5	124.1	1,445.6	2,027.2
ɔmbination of 10 per cent. of fine sand, cent. of clay	2.560	80.3	119.6	1,311.7	1,953.7
-e pure state, a combination of 58 per ı, 36.2 per cent. of aluminia, with 5.8 ..ic oxide	2.533	75.2	115.8	1,228.4	1,891.6
	2.631	112.0	140.3	1,829.5	2,291.8
	1.370	34.8	81.7	568.5	1,334.6
ı mold	2.332	68.7	102.7	1,122.2	1,677.6
le soil	2.401	84.5	119.1	1,380.3	1,945.5

0 per cent. of any constituent, such as phosphoric acid, potash, d amount to from 2,250 to 3,500 pounds, in 1 acre of soil 9 ep.

TIONS OFTEN ANSWERED BY THE ANALYSIS OF SOILS.

ults of soil analysis frequently give decided and satisfactory according to Dr. Voelcker,* to the following questions:

her or not barrenness is caused by the presence of an injurious substance, phate of iron or sulphide of iron, occurring in peaty and clayey soils?
her soils contain common salt, lands flooded by sea water, nitrates or le salts, that are useful to vegetation in a highly diluted state, but injuri- ney occur in land too abundantly?
her barrenness is caused by the absence or deficiency of lime, phosphoric er important elements of plant food?
her clays are absolutely barren and not likely to be materially improved ion, or whether they contain the necessary elements of fertility in an un- te, and are capable of being rendered fertile by subsoiling, deep cultiva- plowing, and similar mechanical means?
her or not clays are usefully burnt and used in that state as manure?
her or not the land will be improved by liming?
her it is better to apply lime, or marl, or clay, on a particular soil?
her special manures, such as superphosphates or ammoniacal salts, can be nrse discreetly, without permanently injuring the land, or whether the ıld rather depend upon the liberal application of farm-yard manure that he to the land all the elements of fertility removed in the crops?
kind of artificial manures are best suited to soils of various composition?

ing to the same authority,† chemical analysis cannot supply e information in regard to barrenness of soils on the follow- s:

barrenness is caused by defective drainage?
nt sterility is affected by a bad physical condition of the land?
oductiveness is affected by the climate?

al Agricultural Society, vol. xiv, p. 338. †*Ibid*, vol. 1, 1865, p. 129.

(4) Whether a soil is barren simply because there is too little of it; or,
(5) Whether it is unproductive simply because a thin surface soil rests on a stiff clay subsoil of great depth.
(6) What is the relative productiveness of different soils?

OBJECTS AND INTERPRETATION OF SOIL ANALYSIS.

For a very full discussion of the objects and interpretation of soil analysis the reader is referred to an article on this subject in the American Journal of Science, vol. 22, pp. 183–197, by Prof. E. W. Hilgard, as well as to the report on "Soil investigation," by the same author, contained in the "General discussion of the cotton production of the United States," Tenth Census of the United States, 1880, vol. v, pp. 67–81, of which the following is a summary:

The claim of soil analysis to practical utility has always rested on the general supposition that, "other things being equal, productiveness is, or should be, sensibly proportional to the amount of available plant food within reach of the roots during the period of the plant's development;" provided, of course, that such supply does not exceed the maximum of that which the plant can utilize when the surplus simply remains inert. This statement is, either tacitly or expressly, admitted by all those who have attempted to interpret soil analyses, and agrees with the accumulated experience of agriculturists.

Many attempts have been made to find solvents that shall represent correctly the action of the plant itself on the soil ingredients, in order that conclusions might be made as to the present agricultural value of a given soil. From sulphuric and hydrofluoric acids to water charged with carbonic acid, as used by Dr. D. D. Owen, the acid solvents have all signally failed to secure even an approximation to the result desired, viz, a consistent agreement between the quantitative determination of the plant food found in the several soils, and the actual experience of those who cultivate them.

The ultimate analysis of soils, as attempted by the German experiment stations, under Wolff's initiative, by the consecutive extractions with acid solvents of different strengths, beginning with distilled water and ending with boiling sulphuric or hydrofluoric acids, affords little or no clue to their agricultural value. Soil analyses do not, like the assay of an ore, interpret themselves to a layman; a column of figures summing up to 100 or nearly so, opposite another column of unintelligible names does not convey much information to a farmer.

In Europe and in the thickly settled portions of this country, the arable soils have nearly all been at some time subjected to cultivation and to the use of fertilizers, thus veiling their original characteristics and rendering extremely difficult the taking of any sample of soil that shall represent correctly, in all respects, the whole of any large field or district. In the greater portion of this country, however, we are able to procure samples of the virgin soil that even the plow has not touched and on which no manures have been applied. The virgin soil and its vegetation are the outcome of long ages of coadaptation by the process of natural selection; and the settler is afforded a means of judging of the productiveness and durability of the land based upon the character of its vegetation.

A soil naturally timbered with a large proportion of walnut, wild cherry, or, as at the South, with the "poplar" or tulip tree, is at once selected as sure to be both productive and durable, especially if the trees be large. The black and Spanish oaks frequent only "strong soils," and an admixture of hickory is likewise beneficial; the occurrence of the scarlet oak lowers the land, and that of pine still more so, in the estimation of the settler.

Having obtained the percentage composition of a soil, how are we to interpret it to the farmer? What are "high" and "low" percentages of each ingredient important to the plant, whether as food or through its physical properties?

The first question is, naturally, whether all soils, having what experience proves to be high percentages of plant food when analyzed by the method given elsewhere, show a high degree of productiveness. This question can be unqualifiedly answered in the affirmative in regard to virgin soils, provided that improper physical conditions do not interfere with the welfare of the plant. But it does not follow that the converse is true, and that low percentage indicates low production.

For instance, we may have a heavy alluvial soil of high percentages and producing a maximum crop in favorable seasons. If this soil be mixed with its own weight, or even more, of coarse sand, thereby reducing the percentage one-half or less, it will not produce a smaller crop, but is more likely to produce the maximum crop every year, on account of improved physical conditions. If we compare the root system of the

grown in the original and in the diluted soil, we will find the roots in the lat-
ame fully diffused, larger, and better developed, not confined to the crevices of a
l clay, but permeating the entire mass, and evidently having fully as extensive a
ace contact with the fertile soil particles as was the case in the original soil.
r far this dilution may be carried out without detriment would vary with different
nts and soils, and must largely be a matter of experiment. A plant capable of
eloping a very large root surface can obviously make up by greater spread for a
greater dilution than one whose root surface is in any case but small. The former
rishes even on poor sandy soils, whilst the latter succeeds and is naturally found
ich heavy ones only, although the absolute amount of plant food taken from the
may be the same in either case.

is obvious that without a knowledge of the respective depths and penetrability
wo soils a comparison of their plant constituents will be useless. The surface soil
h its processes of nitrification, oxidation, carbonic acid solution, &c., in full prog-
must always be distinguished from the subsoil in which these processes are but
ly developed, and where the store of plant food, in which it is generally richer
n a surface soil, is comparatively inert. Hence the obvious importance of samples
rectly taken and the necessity of intelligent and accurate observation on the spot.
he concentration of the available portion of the plant food of soils in their finer
tions has become a maxim. A strong soil is invariably one containing within
ch of a plant a large amount of impalpable matter, although the reverse is by no
ns generally true.

comparison of the composition of soils of known productiveness, and character-
d in their natural state by certain invariable features of plant growth, soon reveals
existence of definite relations, not only to the absolute amounts of certain in-
ents present in the soil, but also to their relative proportions. No ingredient
in this respect a more decided influence than lime, its advent in relatively large
ion, other things remaining equal, changing at once the whole character of
n, so as to be a matter of popular remark everywhere. Only it is not popu-
known, nor has it been definitely recognized by agricultural chemists thus far,
t is the lime that brings the change.

nount of the different soil constituents which may be considered
minum consistent with fertility has already been given.

THE GEOLOGICAL CHARACTER AND DISTRIBUTION OF SOILS IN THE UNITED STATES.

hilst there is a vast variety of detail in the character of the soils
s country in regard to both their physical properties and chemi-
position, still they may be classified under the two heads of
n transport and soils of disintegration, geologically speaking.

of transport include, as has been previously stated, all drift and
materials which have been worn from other rocks by atmos-
agencies and transported to their existing positions by ancient
action, by winds, and by waters. These embrace the majority
all soils occurring in the United States.

Drift soils.—These occupy the principal portion of the States lying
h of the Ohio and east of the Missouri Rivers. According to Pro-
Dana they occur "over all New England and Long Island, New
, New Jersey, and part of Pennsylvania, and the States west to
e western limits of Iowa and Minnesota. Beyond the meridian of
° W., in the United States, they are not known. They have their
uthern limit near the parallel of 39° in Southern Pensylvania, Ohio,
diana, Illinois, and Iowa, whilst the northern is undetermined. South
he Ohio River they are hardly traceable." (Dana's Geology, p. 528.)
Without going into the details of the theory of ancient glacial action,
has given rise to a large amount of study and an extensive litera-
ne term *drift*, as it is commonly employed in geology, includes
s, gravels, clays of various composition and texture, and bowl-
e or less water-worn, all mingled in various proportions and
degrees of fineness, which have been transported from places
r latitudes by glacial action and deposited on the country rock
thickness.

The soils of this drift are usually gravelly, often stony, of va fertility, from the noted fertile lands of Ohio and Western New Y the barren portions of New England. As a whole, these soils finer as they go further southward and westward from New E and Western New York. When overcropped and worn out, as happens, they recover when allowed to rest fallow several years l decomposition of the mingled materials of which they are compo

Alluvial soils.—These are formed from the deposits of fine, materials, sediment, silt, or detritus, by running streams and riv which we have such a notable example at the Mississippi's delta. amount of transportation going on over a continent is beyond ca tion, streams are everywhere at work, rivers, with their large tribu and their thousand little ones, spreading among all the hills and summits of every mountain. And thus the whole surface of a nent is on the move towards the oceans. The word detritus means out, and is well applied to river depositions. The amount of ried to the Mexican Gulf by the Mississippi, according to the Survey under Humphreys and Abbot, is about $\frac{1}{1500}$ of the wei the water, or $\frac{1}{2900}$ of its bulk, equivalent for an average y 812,500,000,000,000 pounds, or to a mass 1 square mile in area a feet deep. (Dana's Geology, p. 648.)

These constitute the "bottom lands," as they are called in the The Red River region, which has become famous as a wheat-prod country, lying partly in Minnesota and partly in Dakota, occupi bed of an ancient lake, known to geologists as Lake Agassiz, and i posed of a black sedimentary soil, exceedingly fine in texture, an fertile and deep. This tract extends southward to Lake Trave the Red River, widening as it proceeds northward and extendi both sides of the river 50 or 60 miles wide where its bed leave country, and expanding to much greater width in Manitoba.

The further westward soils of this class are found the less the a of organic matter they contain, until in the valleys of California are soils of great fertility which contain an exceedingly small amoun course such soils, as those of California just mentioned, are defici the faculty of storing up water for future use, and, however rich may be in mineral constituents, yet in a dry region or one subj periodical droughts, irrigation would have to be resorted to in o get large yields of crops.

Soils of disintegration.—These occupy the undulating parts country lying south of the drift, possessing every variety of cha both in regard to their chemical composition and physical propert their mode of formation indicates, arising from the disintegration subjacent rocks by atmospheric agencies.

Where the underlying rock has been an impure limestone, cont much insoluble matter, the carbonate of lime has been slowly dis out by the action of the carbonic acid contained in the rain, leavi insoluble matter behind. Such soils as that of the "blue-grass" r of Kentucky are so formed, and are often of extreme fertility. (S Kentucky Geological Reports for further details about this regi cluding the chemical analyses of its soils.)

Professor Whitney states that some of the prairie soils of Iow ticularly those where the soil is of nearly impalpable fineness been produced by the slow action of atmospheric agencies on l limestones which formerly occupied their places. In the course the soluble carbonate of lime was gradually dissolved out and away by the rivers and streams to the ocean, and a small amount

ɜ r ne was left, forming the thick prairie soil of the region,
u s s e become blackened by the decay of subsequent abun-
veget ion on it. (Iowa Geological Survey, vol. 1, 1858.)
in the ne lands of Oregon and Washington the underlying rock is
nic, and the soil arising from its disintegration is very fine in text-
, dark in color, of great fertility, and judging from the soils of simi-
ori found in the Rhine region and the Mediterranean in Europe,
e supported vineyards for many years, will probably prove
ery uring and produce a great variety of crops.
two classes of soils run into each other by insensible grada-

The term "prairie soils" is most indefinite as commonly used, includ-
ls of various origin. The prairie region of the West occupies a
ext t of country, extending over the eastern part of Ohio, Indiana,
sout rn portions of Michigan and Wisconsin, nearly the whole of
Iowa, and the northern portion of Missouri, and gradually
ig in ansas and Nebraska into the *plains*, or the arid and desert
which lies at the base of the Rocky Mountains. West of the par-
ol 97° and 100° the country becomes too barren to be inhabited
worthless for cultivation.
region of the greatest cereal production of this country includes
nc noted of the prairie soils, and is nominally in the drift region
gists. Light clays and heavy loams are the best for wheat,
n very heavy clays often produce good crops, both as to yield and
ty, and lighter soils may yield a good quality, but deficient in
tity; moderately stiff soils produce generally the best crops.

HISTORY OF THE SOILS ANALYZED BY THIS DIVISION.

ing the past year over thirty-six soils were analyzed by this divis-
ty of these were analyzed completely and the results obtained
w d in Table IV. The remainder were only partially analyzed,
not tabulated.
his table is presented in the following pages, and the history of each
appended, to be found under its respective serial number:

TABLE IV.—*Analysis of air-dried soils, by Edgar Richards.*

	Prairie soils from Dakota.			Soils received from Hon. Joseph Jorgensen, U. S. land office, Walla Walla, Wash.							Soil received from N. E. Smith.
Soil marked.	Soil marked A. No. 6.	Soil marked B. No. 16.	Soil marked C. No. 7.	Sandy soil from 5 miles northwest of Umatilla, Oreg.	Surface in Grant's ranch, S. 24, T. 11, R. 24.	Two feet of surface in Grant's ranch, S. 24, T. 11, R. 25.	T. 8, R. 26.	S. 26, T. 7, R. 26.	Between Yakima and Columbia River, middle of T. 8 N., R. 27.	S. 12, T. 8, R. 28.	Union Pier, Berrien County, Michigan.
Serial number	1611	1612	1613	1656	1657	1658	1659	1660	1661	1662	2550
Percentage of:											
Hygroscopic moisture	6.275	7.800	7.700	.525	1.800	1.950	1.600	.675	1.325	1.125	8.300
Insoluble silica	69.335	53.415	39.555	78.602	62.165	62.640	63.640	71.585	67.575	64.860	38.955
Hydrated silica		13.620	21.215	5.983	17.600	16.485	16.105	11.480	13.925	16.185	7.575
Soluble silica	.490	.460	.485	.275	.260	.275	.470	.370	.575	.385	.135
Sesquioxide of iron, Fe_2O_3	4.096	4.608	3.264	3.920	4.800	5.248	5.056	4.256	4.736	4.768	.960
Aluminia, Al_2O_3	7.952	9.930	7.382	4.698	6.738	6.818	5.740	5.328	5.510	6.238	3.775
Phosphoric acid, P_2O_5	.112	.112	.224	.192	.192	.224	.224	.216	.224	.224	.715
Lime, CaO	.848	.852	3.898	1.338	1.433	1.329	2.099	1.418	1.428	1.449	.967
Magnesia, MgO	.868	1.535	2.007	.703	.650	.465	1.411	.973	.947	.991	.267
Potash, K_2O	.720	.725	.745	.440	.495	.475	.545	.535	.940	.700	.189
Soda, Na_2O	.945	.640	1.550	1.690	1.560	1.070	.880	.945	1.255	.700	.344
Sulphuric acid, SO_3	.120	.077	.163	.043	.052	.060	.069	.052	.035	.129	.275
Chlorine, Cl	.027	.053	078	.020	.015	.020	.030	.020	.007	.014	.249
Carbonic acid, CO_2	.220	.104	2.530	.005	.002	.116	.110	.090	.116	.000	1.389
Volatile and organic matter	8.905	6.171	10.175	2.045	3.573	3.584	2.040	1.885	1.559	2.600	36.186
Total	100.913	100.102	100.971	100.479	100.844	100.759	99.969	99.828	100.157	100.368	100.272
Nitrogen, N	.324	.179	.414	.044	.069	.075	.069	.140	.224	.067	1.148
Air-dried soil contains:											
Coarse gravel											34.92
											65.08

Soils marked.	Soil received from Jesse H. Blair.		Soils received from William Cartwright, Oswego, N. Y.								
	Lebanon, Boone County, Indiana.		South field.				North field.			Hart's field.	
			Southeast corner.	Southwest corner.	Northeast corner.	Northwest corner.	Southeast corner.	Northeast corner.	Northwest corner.	East end.	West end.
	Soil.	Subsoil.	A 1.	A 2.	A 3.	A 4.	B 5.	B 6.	B 7.	C 8.	C 9.
Serial number	2551	2552	2553	2554	2555	2556	2557	2558	2559	2560	2561
Percentage of:											
Hygroscopic moisture	5.300	3.975	3.950	3.025	5.475	1.825	5.525	5.890	1.440	2.885	1.850
Insoluble silica	58.175	62.950	78.195	80.965	78.560	82.250	69.135	61.575	74.160	70.035	69.615
Hydrated silica	10.970	12.965	3.995	4.490	3.210	4.720	5.975	9.025	8.165	8.505	9.520
Soluble silica	.290	.215	.190	.205	.495	.155	.335	.177	.170	.120	.177
Sesquioxide of iron, Fe_2O_3	2.272	2.720	2.432	2.368	1.952	2.592	2.976	3.360	3.200	3.296	3.360
Alumnia, Al_2O_3	6.397	7.583	4.015	3.740	2.885	3.368	5.284	5.872	4.922	5.468	5.544
Phosphoric acid, P_2O_5	.041	.127	.023	.052	.023	.050	.010	.048	.038	.176	.176
Lime, CaO	1.387	1.280	.350	.440	.350	.564	.753	1.873	.535	.663	.634
Maugesia, MgO	.771	.872	.389	.501	.274	.641	.555	.868	.642	.793	.746
Potash, K_2O	.510	.575	.320	.425	.305	.595	.400	.475	.480	.530	.460
Soda, Na_2O	.725	.280	.165	.215	.220	.240	.990	1.010	1.370	.830	.880
Sulphuric acid, SO_3	.300	.223	.172	.188	.189	.206	.318	.103	.069	.086	.086
Chlorine, Cl	.014	.011	.011	.011	.014	.007	.014	.011	.014	.018	.025
Carbonic acid, CO_2	1.260	1.104	.653	.180	.166	.102	.302	1.283	.605	1.289	.699
Volatile and organic matter	12.165	5.221	5.622	3.370	6.134	2.923	7.798	8.617	4.645	5.511	6.551
Total	100.577	100.101	100.482	100.125	100.252	100.238	100.320	100.187	100.455	100.175	100.823
Nitrogen, N	.574	.252	.156	.101	.162	.109	.221	.313	.153	.204	.218
Air-dried soil contains:											
Coarse gravel	9.64	23.53	32.04	31.86	19.40	30.00	37.73	39.00	48.10	36.00	46.72
Fine material	90.36	76.47	67.96	68.14	80.60	70.00	62.27	61.00	51.90	64.00	53.28

TABLE IV.—*Analysis of air-dried soils, by Edgar Richards*—Continued.

Soils marked.	Soils received from F. Seip, Alexandria, Rapides Parish, Louisiana.				Soil received from Mrs. William Waters, Alexandria, La.		Soil received from William Harris, Louisiana.	
	Alluvial new land, 1 year cleared.	Alluvial medium or chocolate, 20 years in cultivation.	Alluvial red clay, 30 years in cultivation.	Alluvial bottom land front, and sandy, 50 years in cultivation.	Creek bottom low-land, 16 years in cultivation.	Pinehill land.	Alluvial bottom land front, and sandy.	Alluvial bottom land front, and sandy.
	No. 1.	No. 2.	No. 3.	No. 4.	Green label, No. 1.	Green label, No. 2.	White label, A.	White label, B.
Serial number	2574	2575	2576	2577	2579	2580	2581	2582
Percentage of:								
Hygroscopic moisture	4.235	2.000	2.650	.675	1.625	.375	.700	.900
Insoluble silica	47.351	62.968	48.679	77.920	75.647	91.157	83.854	81.590
Hydrated silica	21.231	15.817	22.391	9.080	9.498	3.045	6.313	7.002
Soluble silica	.155	.164	.065	.035	.030	.020	.030	.040
Sesquioxide of iron, Fe_2O_3	4.384	3.200	4.544	2.240	1.440	.800	1.760	1.728
Alumnia, Al_2O_3	10.096	7.156	10.213	4.127	5.333	1.840	3.030	3.246
Phosphoric acid, P_2O_5	.160	.144	.193	.113	.097	.000	.080	.096
Lime, CaO	1.165	2.060	.836	.414	.185	.111	.371	.926
Magnesia, MgO	2.169	1.066	2.547	1.131	.346	.090	.830	1.934
Potash, K_2O	1.470	.930	1.940	.605	.430	.165	.745	.805
Soda, Na_2O	.780	.700	.915	.730	.745	.460	.650	.730
Sulphuric acid, SO_3	.086	.069	.052	.052	.052	.027	.054	.086
Chlorine, Cl	.014	.011	.014	.018	.032	.032	.014	.025
Carbonic acid, CO_2	.549	1.836	1.713	.940	.763	.308	.275	.905
Volatile and organic matter	6.451	2.639	3.462	1.735	4.187	2.142	1.650	.520
Total	100.296	100.260	100.214	100.015	100.410	100.572	100.365	100.583
Nitrogen, N	.209	.120	.137	.078	.140	.059	.073	.073

PRAIRIE SOILS FROM DAKOTA.

l–1613. These soils were forwarded to the Department in July, unaccompanied by any letter or other means of identification from rson who sent them; their analysis was begun in expectation that information concerning them would come to hand before they inished, but all attempts to find out the sender have so far proved iling.

FROM UNITED STATES LAND OFFICE, WALLA WALLA, WASH.

en samples of soil were sent by Hon. Joseph Jorgensen, United land office, Walla Walla, January 5, 1884: "They were taken various points of a section of unsettled country, lying between akima and Columbia Rivers, and west of Wallula, on the Northern c Railroad, comprising about 1,300 square miles of gently rolling u—from 500 to 1,000 feet above the sea-level—the only drawback a lack of running streams of water on any part of it, and but few al springs. Water is reached at varying depths, from 14 to 80 feet. overed, however, with a fine bunch grass, which is accepted here lubitable proof that the smaller grains will grow to maturity and tion. This year (1885) there are some fine crops of wheat on it." samples were taken from "1 to 5 feet" in depth, the soil being ecomposed basalt from 3 to 100 feet deep," and the subsoil is altic rock." No timber is found on it, the prevailing growth being ch grass and sage bush."

6. Sandy soil from 5 miles northwest of Umatilla, Oreg.
7. Surface soil in Grant's Ranch, Sec. 24, T. 11, R. 24.
8. Two feet of surface soil in Grant's Ranch, Sec. 24, T. 11, R. 25.
9. Soil from T. 8, R. 26.
   Soil from Sec. 26, T. 7, R. 26.
1. Soil from middle of T. 8 N., R. 27, between the Yakima and bia Rivers.
2. Soil from Sec. 12, T. 8, R. 28.

se are samples of virgin soils and contain a large amount of the important soil constituents, as phosphoric acid, lime, potash, &c., hould produce abundant crops under favorable climatic conditions. r contents of nitrogen, however, they are, with the exception of) and 1661, somewhat deficient, and this would indicate that nical manures would have to be applied in the future, if, by ex- e cropping, the soil should become unproductive.

FROM N. E. SMITH, UNION PIER, BERRIEN COUNTY, MICHIGAN.

). The sample of soil was sent by Mr. Smith December 10, 1883. ample was taken to a depth of "10 inches from a portion of the ed furrow." The field is "flat" and the depth of the soil "like e is from 8 to 30 inches." The subsoil "to a depth of 2 feet is illed with the infiltration of the surface; this sand in places has small flat stones resembling pieces of broken oyster shells in but flinty in character." The timber was "yellow pine and larch, with a dense growth of alders, tag and black, and blueberries; e was covered with moss 2 feet deep."

owing crops have been raised:

r, light grain. Buckwheat, 25 to 30 bushels to the acre. Corn not a [illegible], one hundred and one in a hill, but none larger than a walnut.

Cabbages, radishes, melons, squashes, and beans have succeeded. My largest experience is with onions from the seed; the first year, after getting 2 inches high, many turned yellow on top and finally died; second year they were better, and third year good.

In regard to manures used:

In plats as follows: First year, ashes and lime, fresh slaked; ashes 200 bushels to the acre, lime 2 tons to the acre; crop failed. Same plat, second year: Hen droppings at the rate of 10 cubic yards per acre, composited with plaster, and just previous to application mixed with twice their bulk of white-ash ashes. Yield, 300 to 400 bushels per acre. Third year: Garden City phosphate, 1,000 pounds per acre. Yield improved. This year (1885) applied nitrate of soda 150 pounds, Garden City phosphate 800 pounds per acre; the crop is of fair promise in the main, but there are spots where a good stand has disappeared; in these barren spots there will be found small patches of fine onions marking the spot of a fire. The original plat, treated this year as above, now (July) promises a fine crop. This year I have taken in new ground with the above-stated results.

The sample was dried to make it more secure when sent through the mail.

This sample, as the most casual inspection of the analysis will show, contains an enormous amount of organic matter, and to this may be attributed the poor success met with in raising crops, as nothing is more injurious than the action of the organic acids, arising from the decay of the organic matter in the soil, on vegetation when they are present in excess. For, however fertile the soil may be in other respects, until this excess of humic acids is neutralized or otherwise got rid of, the prospect of raising remunerative crops is very slight. The remedy for such a state of affairs is a heavy dressing of lime, from 2 to 5 tons of quicklime per acre, depending on the quantity of the organic matter present; that is, from .05 to .5 per cent. by weight of the cultivated soil. The lime or marl used has the power of neutralizing the humic acids. Burning might also be resorted to, but the use of lime will probably, in such cases, prove more beneficial. The lime should be used as a top dressing, as it has a strong tendency to sink into the subsoil, and so it should not be plowed in, but kept as near the surface as possible. The ground should be plowed first, then the lime spread and simply harrowed in. This dose of lime must not be repeated yearly, but at intervals of six or eight years 1 to 2 tons of lime made into a compost may be used. It is best applied in the early winter, so that the lime may work into the surface before the spring growth commences.

The amount of nitrogen and of phosphoric acid is very large, and that of lime, of potash, and soda is abundant for the raising of any crop when the excess of organic acids has been destroyed. With the exception noted, the analysis shows this soil to be a very fertile one, containing an abundant supply of all the necessary plant constituents.

SOIL AND SUBSOIL FROM JESSE H. BLAIR, LEBANON, BOONE COUNTY, INDIANA.

2551–2552. The samples were sent January 5, 1884, having been taken on September 12, 1883, "from what is popularly called a prairie region, but what is thought to have once been a lake, in the northern part Hendricks County; it was dry and very difficult to get a good sam The sample of soil was taken by digging a hole an inch square, then sl ing a slice downward, about 6 inches deep. The sample of subsoil v ken from the next 6 inches below the surface sample. The soil is rich solid, and about 18 inches deep, and in a meadow of timothy grass. The subsoil is tough clay, about 3 feet deep, then sand or gravel. No tim swamp or wet prairie, and lately redeemed. No manure has bee used. The following crops were raised: Corn, 75 bushels per acre orge then a large yield of hay. It produces

crop of grass; wheat does fair; the corn is not as good as clay field.

analyses show that an abundant supply of the necessary plant uents are present, and that the soil should be very fertile. The t of nitrogen in the soil is very large.

SOILS FROM WILLIAM CARTWRIGHT, OSWEGO, N. Y.

-2561. Samples taken from three distinct fields on which an acre ar beet was grown in 1883, were sent December 24, 1883. Samples 53–2556, marked "A, 1, 2, 3, and 4," were taken from "a square irds-acre plot at different points, SE., SW., NE., NW. of the field." es Nos. 2557–2559, marked "B, 5, 6, and 7," were from "a triangu- -third-acre plot," taken at the different angles. The two remain- nples, Nos. 2560, 2561, marked "C, 8 and 9," were from "a field of beet a mile distant" from the other two fields, "cultivated by r party, on a rectangular plot of half an acre; the samples being the ends, E. and W. of the rectangle."

e general character of all the fields was a gentle slope, enough to ater readily. The samples were cut out with a spade a couple ks after the crop was gathered, each about 6 inches wide and deep; l of field A was 8 to 10 inches deep; that of field B probably 1 ld C was rather stony soil, 8 to 12 inches deep. The subsoil of lds was hard-pan, with large stones and bowlders imbedded. a plow was used in preparing fields A and B. No timber was the fields; the woods adjacent, I believe, were maple. The as under cultivation for years. Fields A and B had been r n in the spring of 1882 with barn-yard manure, and an nt crop or corn and beans gathered that year. A succession of g crops had been taken previously from these two fields, but I ot the statistics concerning them. No manure was directly aprevious to beet planting on A and B, but I was informed that on barn-yard manure was strewn midway between the beet rows, were 30 inches apart. In fields A and B, after harrowing and , the seed, sugar beet was sown, part by hand and part with a arrow drill, in rows 18 and 20 inches apart on the 4th and 9th of 883. All work after hoeing, thinning, and weeding was entirely . The crop weighed nearly 18 tons."

alysis of the beets grown on these different fields is as follows:*

Analysis of sugar beets from William Cartwright, Oswego, N. Y.

Variety.	No. of analysis.	No. of beets taken.	Total weight.	Weight without neck.	Sucrose.	Glucose.	Ash.	Purity.
			*Kilos.**	*Kilos.**	*Per cent.*	*Per cent.*	*Per cent.*	*Coef.*
south field, north end	1	5	2.838	(†)	12.12	.29	1.022	74.6
south field, south end	4	5	2.457	2.238	15.34	.17	.755	83.0
north field, north end	5	5	2.776	2.610	15.32	.16	.802	85.0
north field, south end	6	5	2.795	2.540	15.20	.12	1.061	82.0
's field	11	5	2.915	2.810	12.74	.40	.897	79.0

* A kilogram is equal to 2.2 pounds. † Not taken.

yses of these soils show the great difficulty of obtaining a il from a field which shall represent its average quality, greatest care is taken.

* Chemical division, Bulletin No. 3, 1884, p. 26.

In regard to the analysis, Nos. 2553–2556, taken from the sou field at different corners of the plot, the three samples, A 1, 2, and contained practically the same amount of coarse sand and gravel, wl A 3 has about 10 per cent. less. All four samples show that the deficient in phosphoric acid and lime, and probably would be mu benefited by the use of a lime phosphate or similar fertilizer; its co tents of other soil constituents are ample for fertility.

The samples Nos. 2557–2559, taken from the north field, show th this soil is likewise deficient in phosphoric acid, but is richer in its co tents of lime and nitrogen and in other constituents similar to of the south field. The amount of gravel also varies in the dif samples.

The two samples, Nos. 2560 and 2561, taken from Hart's field, differ their content of coarse gravel, but contain an abundance of phospho acid and other soil constituents.

For the purpose of comparing soils on which such sugar-produci plants as sorghum and sugar beet have been grown, the analyses r by Mr. Clifford Richardson, in 1882 and 1883, may be referred to.*

SOILS FROM RAPIDES PARISH, LOUISIANA.

2574–2577. Soils from the cotton plantation of F. Seip, situated Bayou Rapides, near Alexandria, Rapides Parish, Louisiana:

All of these four samples were taken from the same plantation, and their differen simply arise from the greater or less distance from the water-course in which plantation lies; near the stream the soil is lighter or sandier; as it recedes it becoi heavier, until finally the red clay soil is reached. The land is a part of what known as the "bottom" or alluvial lands of the Red River Valley. These lands level, having but a slight elevation above tide water, and in their native state c ered by a growth of heavy timber or forest. They lie near the Red River, and drained by smaller streams or bayous running into the Red. The principal tim growth is sweet gum, various kinds of oak, ash, hackberry, sycamore, elm, mulb pecan, cottonwood, &c. Trees are often from 3 to 6 feet in diameter, and a heig 75 feet is not uncommon. Some of the land has been recently cleared, whilst parts have been for many (seventy or more) years in cultivation.

The samples were, in every instance, taken to a depth of 6 inches and 6 inc square, or as near that as practicable. The character of the soil for some 10 feet more is principally a red clay, with an occasional mixture of clay and sand. Th face for a few inches is a black mold, arising from the decay of vegetable matter, leaves of the forest, &c. Beneath the red clay is generally found a blue or gray clay.

The crops grown consist of corn and cotton, the latter principally. The yi would average in the past five years 250 pounds of lint cotton per acre; under fa able conditions of weather and good culture, 500 pounds and over were obtai Corn would average about 25 to 30 bushels per acre. No manure was used.

2574. This sample was taken from a "field of some 8 or 10 acr one year cleared, the remainder, 300 acres in extent, being heavily bered, but of a similar formation."

2575. This soil has been twenty years in cultivation and proved fertile, and is a sample of medium or "chocolate" land.

2576. This soil has been longer in cultivation than either of the t preceding, viz, thirty years, and is a specimen of the fertile red clay

2577. This is a sample of the front and sandy alluvial lands, and been fifty years in cultivation, producing a somewhat smaller crop t No. 2575.

2579–2580. Soils from Mrs. William Waters, samples collected by H. B. Cummings, Alexandria, La.

* Investigations of Sorghum as a Sugar-producing Plant; season of 1882. Report, pp. 38 &c.

have been produced. The soil is only a few inches deep, and
oil consists of sand, gravel, and clay."
nd 2582. Soils from the plantation of William Harris, on Bayou
near Alexandria, La.
s are of the same formation as those taken from Mr. Siep's
, d possess similar characteristics, being alluvial bottom
the Red River Valley.
d to the analyses, Nos. 2574 and 2576, the samples agree very
their contents of the more important soil constituents, viz,
c acid, potash, lime, &c., though the amount of nitrogen in the
ly double that in the latter, which might be expected
irgin soil.
575 and 2577 show a less amount of potash, phosphoric acid,
ogen than No. 2574, owing to their having been under cultiva-
longer period, and no attempt having been made to keep up
ly by the use of manures. As far as chemical analysis is con-
all these soils are rich enough in all the necessary soil constitu-
the continued raising of abundant crops, though the continued
, year after year, without the use of manure is not to be recom-
if an abundant yield is to be maintained. A moderate appli-
farm-yard manure, or the ashes of the cotton plant and seeds
ith lime would certainly result in an increased yield.
le of creek bottom land, No. 2579, is deficient in its contents
and the application of this fertilizer would undoubtedly increase
nctiveness of the land. In other respects it is sufficiently rich.
alysis of the sample of pine-hill land, No. 2580, shows the com-
e of phosphoric acid and a great deficiency of lime; in fact
ly all pure quartz sand. It would seem to be a hopeless task
such soils to any degree of profitable fertility, as there is a
leficiency of the most important plant constituents. The con-
pplication of such fertilizers as South Carolina phosphates
g both lime and phosphoric acid and farm-yard and cotton-seed
with the admixture of some of the red clay soils, would in the
time greatly improve such lands, and as they cover nearly

three-fourths of the area of this parish, some such course as above indicated will have to be adopted. The mere application of lime in liberal quantities would have a beneficial effect.

The application of lime to the soils, Nos. 2581 and 2582, from Mr. William Harris, would increase their fertility, as they are somewhat deficient in their contents of this constituent.

H. W. WILEY,
Chemist.

Hon. NORMAN J. COLMAN,
Commissioner.

ORT OF CHIEF OF DIVISION OF FORESTRY.

I respectfully submit the following report of the work of the
n of Forestry for the past year.
act of Congress under which this division of the Department of
lture is organized defines its work as that of "ascertaining the
amount of consumption, importation, and exportation of timber
her forest products; the probable supply for future wants; the
best adapted to the preservation and renewal of forests; the in-
of forests upon climate, and the measures that have been suc-
ly applied in various countries for the preservation and restora-
planting of forests."
ne working of this division a liberal construction has been put
his act, and the endeavor has been made to do whatever might
te the interests of forestry in our country. The limited appro-
ns made for the division have not allowed it to make its inves-
ns as extensive or complete as is desirable. The pettiest king-
nd even duchies of Europe, not so large in extent as some of our
expend annually in the care and management of their forests
investigations relating to them, sums far larger than are appro-
l by our Government for similar investigations relating to an area
ost continental extent. With the means at our disposal, however,
le knowledge has been gained, the publication of which has
been of much service to the people. The annual reports of this
n, and the four volumes of its special reports, embody a large
t of information in regard to forestal matters both at home and
. In some directions these reports are exhaustive, and have been
d as authoritative in regard to the subjects to which they relate.

IBITION OF WOODS AND WOOD PRODUCTS AT NEW ORLEANS.

he beginning of the year I undertook, in connection with the
ntendent of Buildings and Grounds, and under the act of Congress
ng for contributions from the various Departments of the Govern-
o the Centennial and Cotton Exposition at New Orleans, to pro-
ne interests of forestry by procuring and sending to that exposi-
collection of useful articles which are manufactured from our
native woods. The object was to impress upon the minds of
to the exposition, by placing before them a large collection of
ticles in one view, a conviction of the great variety of our woods
eir practical value as furnishing us so many useful and even in-
able articles of daily employment. For this purpose I visited,
on, several of the wood-working establishments of the Eastern
and reached others in different places by means of correspond-
Mr. Saunders was able, by correspondence and through agents,
many other factories, and thus a quite extensive collection was
I believe this proved one of the most attractive exhibitions
Orleans. It conveyed information also of permanent value. It

showed even those most ignorant in regard to the number and value our woods how dependent we are upon them for many of the conve iencies of life, and how deserving the forests are of protection.

TREES ON THE WESTERN PLAINS.

As showing the practicability of successful tree culture in the regions of the West, where such culture has been pronounced by ma to be impossible, one of the field agents of the division transplant several hundred trees of various kinds from the western portions Kansas and Nebraska, and even from regions beyond, where t y been artificially planted, and set them out upon the exposition gr at New Orleans, there to put out their leaves afresh, thus giving oc lar demonstration that trees will grow, because trees do grow, und what many have regarded as forbidding conditions. Within a few yea many millions of trees have been planted in portions of Kansas a Nebraska which before were nearly if not quite destitute of trees, a they have grown and flourished. The established fact that trees, v uable for fruit, for shelter, and for timber, can be successfully cultivat on much of what has been called the Great American Desert is great practical importance from an agricultural point of view, and w be the means of attracting settlers to that region who otherwise wo turn away from it. It does not follow, because any portion of t country is now or has been for a long time treeless, that it must rem so, or that this is its natural condition. We know of places now bar deserts which once were fertile and abounded in trees. The hand man has brought them to their bare and barren state. And as t hand of man has done this, so it can restore to them, in many es least, their verdant covering by restoring to them the proper eg and conditions of tree growth. But little of the earth's surface, cert within the temperate and equatorial regions, is naturally doomed sterility. France and Germany have reclothed with trees large d tricts of drifting sands, and in our own country the dwellers upon Ca Cod, which is to so great extent a barren sand area, though in ea times well clothed with forests, have found it comparatively easy to tablish there groves of the pine; and the pine once established as a shi from the salt spray and violent winds of the ocean, other trees, such flourish in the same latitude, can be added to the pines. It is imposs to say as yet where a tree cannot be made to grow.

NEW VOLUME OF REPORTS ON FORESTRY.

Early in the year a new volume, the fourth in the series of Repo on Forestry, was published, embodying in part the results of the vestigations made by this division during the two preceding yea Among the more important contents of this volume may be mention a very full report from six of the prairie States in regard to the succ which has attended tree-planting there. This report was made fr information received in reply to thousands of circulars sent to all pa of those States. The replies received were tabulated and digested, a so arranged as to convey specific information, easily referred to, in gard to each county in the States from which reports were receiv This, of course, was but a gleaning of the wide field presented for estigation. It was, however, an approximate exhibition of the ad ation of various trees to particular localities which may be of m ervice to planters in the future, enabling them to avoid n iling themsel[illegible]erience.

other report, compiled in a similar way, presented an exhibit of the t to which the native forests of the country have been cleared off or what purposes, the damage occasioned by forest fires, and other relating to the subject. By means of a graphic chart, the steady apid destruction of the forests in one State, in regard to which we special official information, was shown for a period of nearly thirty As no causes of forest destruction have been in operation in tate which have not been at work in other and neighboring States, t was made with the presumption that it would fairly represent rest condition of a considerable region respecting which we can- ire the same official evidence that is furnished in the case of ticular State referred to.

CONSUMPTION OF WOOD FOR RAILROAD TIES.

ery complete and exhaustive report was made also in regard to sumption of the forests for the purpose of furnishing ties for 0,000 miles of railroad existing in 1884. The report shows the t and kinds of wood used by the several roads from which infor- could be obtained, comprising about 63 per cent. of all. The from which the ties were procured are also specified, the season year in which they were cut, and their ascertained durability. the information obtained, it appears that to furnish the requisite required the available timber growing on an area equal to that States of Rhode Island and Connecticut, and estimating that ed to be replaced by new ones once in seven years on the aver- ere would be required annually for this purpose the available growing on 565,714 acres. Allowing again that a growth of years is necessary to produce trees of proper dimensions for ties, ld require 16,971,420 acres of woodland to be held as a kind of d reserve to supply the annual demands of the existing roads, to thing of the demands of new ones. This is between 3 and 4 per f the woodland of the United States, exclusive of Alaska.

MAPLE SUGAR INDUSTRY.

ther complete and valuable report contained in the volume referred one on the sugar product of the maple tree. From this it will be at, reducing the maple sirup made to its equivalent of sugar, the roduct of sugar from the maple for the census year was 50,944,445 , or a little more than one-twelfth of the entire sugar product of ntry, including that from both sorghum and the sugar cane. Of nulated sugar made in the country, that from the maple forms 17 t.

is an important showing. The sugar maple is one of the most distributed of our native trees, and is especially at home through- arge part of the northern portion of the country, abounding where ghum will not ripen. The sugar from the maple is identical in on with that from the cane. It can be produced at compara- ittle expense. Experience seems to show that the sap taken trees during the brief sugar-making season does not percepti- the vitality of the trees or lessen their ultimate value for fuel which purposes the maple ranks very high. The produc- takes place, also, at a comparatively leisure season of the lly any other business is claiming attention. The fuel ne reduction of the sap to sugar is scarcely, if at all, more

than can be supplied by the proper clearing up of the forest or and the removal of fallen branches or the refuse left in the usual c of fuel for home use or for market. There is no expense of planti cultivation, as in the case of the cane or of sorghum. The prod of whatever amount of maple sugar is made may be considered, fore, as almost clear gain. And the production may be indefinite tended. It may be carried on upon a large or small scale and upo farm or homestead, even where there are but few trees. It is emi a home or domestic industry, attended with but little expense, manifest advantage. Vermont now produces sugar and sirup amount of more than 12,000,000 pounds a year, or about 36 poun each of her inhabitants. She might easily double this amount, say increase it tivefold. There are twenty of our States at le which the manufacture of sugar from the maple might be carried the same proportion. It would seem, therefore, that with the pro production of sugar from the sorghum plant throughout all the except those of the extreme north, where frost prevents its r and with the Southern States so well adapted to the growth cane, the time need not be distant when our entire supply of su be derived from our own soil.

INVESTIGATIONS DURING THE PRESENT YEAR.

Since the publication of the last report this division has been further investigations, by means of circulars widely distributed agents in the field. These circulars called for information in the abundance or scarcity of the forests in the several States a tories; the kinds of trees found growing naturally; to what e forests have been cut, and for what purposes; whether the fo creasing or decreasing in extent, and at what rate; whether an in the streams have been noticed as the result of the remova forests; whether floods and summer droughts have increased effect, if any, the removal of the forests has had upon the annua of rainfall; also to what extent forest trees have been planted, what success; what kinds that have been planted have failed, causes of failure; whether proper care and attention have be them, and what proportion of trees planted are growing and and whether the planting or removal of forest trees has produ perceptible climatic changes.

Much time has necessarily been occupied in comparing the re these circulars and tabulating them. The results thus obtai furnish much valuable material for another volume of reports estry. Meanwhile the returns may be summarized in part, as

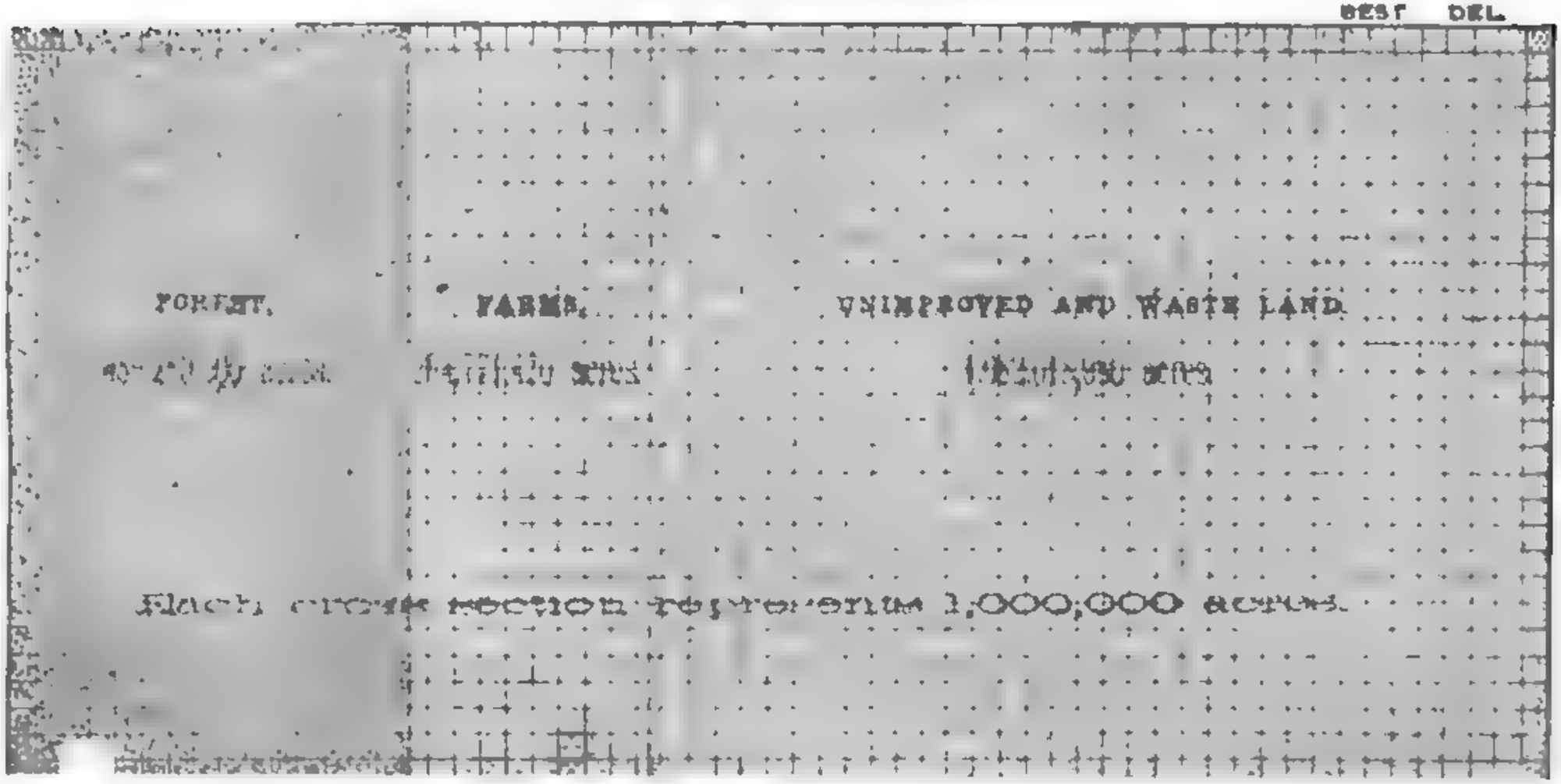
PRESENT FOREST AREA OF THE STATES AND TERRITOR

The extent of our national territory is so great, so much of it out sparsely settled, and so much still unsurveyed, that it is ve ult to ascertain with accuracy how much of it is clothed with n taking the last census, the General Government endeavored irst time to take account of the forests of the country in anyth complete manner. Hitherto, it had only taken account of th vere embraced in farms, which left a large amount of forests u red. The compilations of the last census have given us a very ble body of information in regard to the wooded area of t With the aid of that census and other sources of informa

ED STATES.

	Forest area.	Farm area.
	Acres.	*Acres.*
Rhode I	200, 000	300, 000
Delawar	300, 000	800, 000
Connec	650, 000	1, 700, 000
	2, 330, 000	2, 100, 000

Proportion of forest, farms, unimproved and waste land in the United States (exclusive of Alaska and Indian Territory) in 1885.



has been made to ascertain with greater precision the extent of
sts. Still it is difficult to ascertain their locality and extent
al degree of accuracy that is desirable. It has been a matter of
not unfrequently, in making inquiries on the subject, to find
accurate knowledge persons have of the forest condition of
vn State. Most widely discrepant accounts have been received
rsons living n the same State or Territory. In several cases
te officials, when applied to, have been able to give no satisfac-
ormation. There seems to be no accepted standard by which to
ne what shall be classed as forest land, how abundant the trees
or in what proximity to each other, in order to bring them
he classification of forest, in distinction from waste or pasture,
t is not claimed that the following table is minutely accurate,
believed to be a closer approximation to a correct representa-
the present extent of our forest area than has hitherto been
As showing at once the distribution and relative amount of
n the various States and Territories, another representation has
de graphically, and is herewith also shown:

The States.	Total land area.	Forest area.	Percentage of forest to total area.
	Acres.	*Acres.*	
	32,985,600	17,500,000	53.1
	72,268,800	10,000,000	13.8
	33,948,800	20,000,000	58.9
	99,827,200	20,000,000	20.0
	60,332,800	10,000,000	15.1
	3,106,800	650,000	21.0
	94,528,000	3,000,000	3.2
	1,254,400	300,000	23.9
	34,718,600	20,000,000	57.6
	37,747,200	18,000,000	47.7
	53,945,600	10,000,000	18.5
	35,540,000	3,500,000	9.8
	22,982,400	4,500,000	19.6
	35,504,000	2,300,000	12.7
	52,288,000	3,500,000	6.7
	25,600,000	12,800,000	50.0
	29,068,800	13,000,000	44.6
	19,132,800	12,000,000	63.7
	6,310,400	2,000,000	31.7
te	5,145,600	1,000,000	19.6
	36,755,200	14,000,000	38.1
	50,591,200	30,000,000	59.3
	29,657,600	13,000,000	44.0
	43,090,400	16,000,000	36.4
	[illegible]	25,000,000	26.9
	48,758,400	1,500,000	3.1
	70,233,600	2,000,000	2.8
hire	5,763,200	3,000,000	52.0
	4,771,200	2,330,000	48.8
	78,374,400	8,000,000	10.[illegible]
	30,476,800	8,000,000	26.[illegible]
na	31,091,200	18,000,000	57.9
	28,086,400	4,500,000	17.3
	60,518,400	20,000,000	33.0
a	28,790,400	7,000,000	24.3
i	694,400	200,000	28.8
na	19,308,800	9,000,000	46.6
	26,720,000	11,000,000	41.2
	167,865,600	40,000,000	23.2
	52,601,600	4,000,000	7.6
	5,846,400	1,000,000	32.5
	25,680,000	13,000,000	50.6
	42,893,200	20,000,000	44.3
	15,772,800	9,000,000	57.0
	34,848,000	17,000,000	48.8
	62,448,000	7,800,000	16.9
tes	1,856,070,400	489,280,000	26.4

DISTRIBUTION OF THE FORESTS OF THE UNITED STATES.

In the United States, exclusive of Alaska, the District of C and the Indian Territory, there are 38 States and 8 Territories, a total of 46. The superficial area of these 46 is 2,900,107 square or 1,856,070,400 acres.

The total forest area is 489,280,000 acres, or 26.4 per cent. of perficial area.

The group of States and Territories lying west of the ninety-fifth ridian, viz, Arizona, California, Colorado, Dakota, Idaho, Kansas, M tana, Nebraska, Nevada, New Mexico, Oregon, Texas, Utah, Washi ton, and Wyoming, have an area of 1,900,159 square miles, or 1,216,101,(acres, which is 65.5 per cent. of the whole area of the United Stat with the exceptions above noted.

The area of forest in this group, exclusive of the Indian Territory only 184,800,000 acres, or 15.2 per cent. of the superficial area.

If California, Montana, Oregon, Texas, and Washington, which c tain the largest proportion of woodland, are left out of the calculati the superficial area of the remaining States and Territories of the gr would be 751,776,000 acres, being 40.5 per cent. of the United Stat only 59,800,000 acres, or 8.1 per cent. of which is in forest.

The group of States, 30 in number, lying east of the ninety-fifth ridian, have an area of 1,000,000 square miles, or 640,000,000 acres, be 34.5 per cent. of the whole area; 304,280,000 acres, or 47.5 per cent which is in forest.

The Eastern and Northern States forming a part of this group, Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, C necticut, New York, New Jersey, Pennsylvania, Delaware, M West Virginia, Ohio, Indiana, Illinois, Michigan, Wisconsin, Minn Iowa, and Missouri, have an area of 313,547,200 acres; 139,180,000 or 44.4 per cent. of which is in forest.

The Southern States, forming a part of the group east of the nin fifth meridian, viz, Virginia, Kentucky, Tennessee, North Carolina, So Carolina, Georgia, Florida, Alabama, Mississippi, Arkansas, and ana, have an area of 326,421,600 acres; 165,100,000 acres, or 50.6 cent. of which is in forest.

It will be of interest to notice that while the section or group of St west of the ninety-fifth meridian contain 65.5 per cent. of the whole perficial area, it contains but 37.8 per cent. of the forest area of country; and the group east of the ninety-fifth meridian, while it tains but 34.5 per cent. of the whole superficial area, contains only per cent. of the area of the forest.

The group of 19 Eastern and Northern States contains 16.9 per c of the total superficial area and 28.4 per cent. of the forest.

The group of 11 Southern States contains 17.6 per cent. of total su ficial area and 33.8 per cent. of the whole forest area of the Un States.

The Western group contains 889,680,000 acres superficial area, or 2 per cent. more than the Southern group, and only 19,700,000 acres, per cent. more of forest area.

...ENCES.

The cost of building and repairing fences in the United States, for 1 according to the reports of the last census, amounted to 7,762,4 East of the ninety-fifth meridian there were 239,147,208 ...bered farms. The cost of building and repairi... c

was $65,327,107, or 84 per cent. of the cost for the United
e average cost per acre was 27.3 cents.
is whole section was under the operation of the "stock law"
saving in timber, time, and money would be immense, while
ge to the young growth in the forest would be incalculable.
forest fires, hogs, cattle, and sheep are most destructive to
t trees.
ple and comparison in the cost of the two methods, take the
Mecklenburg, in North Carolina. This county has had the
" in force for many years. According to the census reports
43 acres in farms. The cost of building and repairing fences
$6,215, an average of 4.3 cents per acre. If, therefore, the
ding and repairing the fences on farms where the "stock
force is 4.3 cents per acre, then at the same rate for the
acres in farms lying east of the 95th meridian the cost
nly $10,283,329, an annual saving of $55,043,778, or an av-
5.59 to each farm.

EXPORTS AND IMPORTS OF WOOD.

[From the Bureau of Statistics.]

od, and manufactures of; also firewood, sawed lumber, shooks, shingles, eadings, and timber hewed, sawed, or in logs, &c., years ending June 30, 5.

	1884.	1885.
tured in which wood is the chief material	$24,275,128	$19,446,442
lements	3,443,250	2,561,119
t of, for tanning	292,851	346,218
tables, and parts of	55,631	49,709
rse cars, and parts of	1,582,459	1,495,475
and freight	1,444,039	369,053
	106,209	69,840
nts	1,079,116	941,944
pitch, turpentine	3,119,200	2,294,563
line	3,885,500	2,690,231
	39,283,985	*30,203,994

* Showing a decrease for the year ended June 30, 1885, of $9,019,991.

ing the value of wood, and manufactures of, imported into the United States years ending June 30, from 1870 to 1885, inclusive.

Years	Free of duty.	Dutiable.	Duty.
	$718,800	$9,121,840	$1,976,000
	1,835,096	9,053,360	1,964,153
	1,322,220	9,310,252	2,088,802
	2,114,147	11,218,576	2,143,030
	2,357,733	8,374,112	1,556,658
	2,052,072	5,757,995	1,114,840
	1,445,818	4,725,502	965,173
	1,352,908	3,908,196	865,535
	1,543,847	3,782,710	849,951
	1,877,468	3,978,982	933,446
	2,955,604	6,150,086	1,316,952
	3,657,343	7,496,816	1,536,025
	4,494,506	8,967,291	1,696,867
	4,865,094	9,530,364	1,703,090
	4,353,849	9,367,833	1,609,810
	3,526,021	9,103,041	1,469,848

a the "free of duty" list for 1884, are 1,932,674 railroad ties, valued at $383,718.80.
of paper pulp, mostly wood, amounted to 1,320,383 pounds, in 1883 to 2,002,290
o 26,780,406 pounds.

MANUFACTURES OF WOOD.

[From the Census.]

Comparisons of some of the specified industries using wood or other forest prod or as their principal material.

Industries.	1870.			1880.		
	Number of establishments.	Value of materials.	Value of products.	Number of establishments.	Value of materials.	Va pr
Agricultural implements	2,076	$21,478,925	$52,066,875	1,943	170	
Artificial limbs	.....	.....	.....	33		
Baskets	127	158,109	594,789	304		1
Billiard tables	.....	.....	.....	46	1,	2
Boxes, cigar	.....	.....	.....	221	1,389,	2
Boxes, wooden, packing	489	4,236,745	8,222,483	602	7,674,921	12
Carpets, wood	.....	.....	.....	5	23,500	
Carriage and wagon materials	.....	.....	.....	412	4,781,095	10
Carriages and sleds, children's	58	495,281	1,482,883	67	868,054	1
Carriages and wagons	11,847	22,787,341	65,862,837	8,841	30,597,086	64
Cars, railroad, street, and repairs, not including steam railroad establishments	170	18,117,707	31,070,784	120	19,780,271	27
Charcoal	.....	.....	.....	175	320,725	
Cigar molds	.....	.....	.....	3	55,210	
Clock cases	5	71,479	111,430	2	19,000	
Coffins	642	1,412,078	4,026,989	769	3,776,222	8
Cooperage	4,961	12,831,796	26,863,734	8,898	18,441,064	33
Engraving, wood	.....	.....	.....	167	68,605	
Furniture	5,423	21,660,837	57,962,547	4,843	31,416,768	61
Furniture, chairs	529	8,979,743	10,567,104	884	4,443,433	9
Handles, wooden	.....	.....	.....	206	697,320	1
Kindling wood	70	486,642	930,294	213	1,403,010	2
Lasts	60	137,657	665,703	62	221,905	
Looking-glass and picture frames	320	2,466,313	5,962,235	645	4	8
Matches	.....	.....	.....	87	4	4
Models and patterns	.....	.....	.....	230		
Musical instruments:						
Not specified	.....	.....	.....	84		
Organs	.....	.....	.....	171	2,	6
Pianos	.....	.....	.....	174	5,	2
Refrigerators	27	192,409	506,463	71		1
Sash, doors, and blinds	1,605	17,581,814	36,625,806	1,258	20,	
Sewing-machine cases	.....	.....	.....	18		
Ship-building	762	8,252,394	17,910,828	2,188		
Toys and games	.....	.....	.....	106	95,833	
Veneering	10	128,918	241,750	5	137,082	
Washing machines and wringers	.....	.....	.....	61	587,648	1
Wheelbarrows	23	106,420	472,720	22	101,858	
Wheelwrighting	.....	.....	.....	10,701	6,703,677	18
Wind-mills	.....	.....	.....	69	523,594	1
Wood-pulp	8	29,500	372,350	50	910,835	2
Wood, turned and carved	733	1,648,008	4,959,191	710	2,940,630	6
Wooden ware	269	1,623,694	4,142,124	287	2,635,720	8
Total	30,209	139,876,830	331,271,219	35,243	233,933,030	46

INCREASE OR DECREASE OF FORESTS.

The information gained in reply to the circulars sent out by the on confirms the conclusions arrived at in taking the last nation sus, and which intelligent observers had reached at an earlier hat our forests are decreasing at a rapid and, in a large portion country, at an alarming rate. In a few of the Western States, K and Nebraska, and in the Territory of Dakota, the very small ext natural tree growth and the manifest need of shelter from cold an ent winds have led the people of that region to protect the ex forests and to engage quite extensively in the planting of new

stimated that in Nebraska there are now not fewer than 700,000 of planted forest trees. In Kansas there are nearly as many. In of the New England States, also, it is probable that the wooded s not diminishing. Through the illness and death of the agent in charge the northeastern portion of the country the circulars nly partially distributed there, and we have no authoritative statis- n subject. But in several of those States attention has been ior considerable time to the value of forests apart from their use mber and fuel, and there has been a growing disposition to secure proper conservation. In Maine, which was formerly our greatest e of lumber supply, it is understood that only such an amount is om the great pine and spruce forests annually as is equal to the growth. This is as it should be. The forest capital is not dimin- but a steady revenue is derived from it, which may be perpetual, incidentally many great benefits to the State are secured by such andry of the forests.

Massachusetts and Connecticut, which were never covered with forests as those of Maine, and therefore never offered the same ations to the ax of the lumberman, it is believed that the wooded actually increasing. The people are learning that much of their , nilly, and swampy land is more profitable for the growth of trees ny other crop, and they are allowing nature to clothe it with the ng which it formerly had.

in what may be called the lumbering regions of the country, es- ly where the pine is abundant or found in considerable masses, rk of destruction is carried on at an alarming rate. The farmer, g a portion of his farm only covered with trees, will almost natur- prudent in the consumption of them and can easily be led to see o sweep them off at once for cord wood or lumber, though it might desirable sum of money in his pocket, would be to lessen the t and injure the quality of all the crops of his cultivated fields, at in the end he would be a loser. But the lumberman is open to h convictions. He is concerned with no crops except those of the His aim and interest are to level the trees and convert them into r as speedily as possible. He sees in the tree, or thinks he does, money, and he aims to secure it by the most rapid means. He consideration for grain fields or climatic results, for rainfall or falls, except as they are connected with the cutting and marketing logs. He is blind to all such things. The same is true of the He has no thought of the general benefit of forests to those near them, much less of their possible benefit to those who are emote from them. Trees to him are simply good for mine props uel for the conversion of his ores into marketable metal. The rman and the miner alike cut with reckless profusion, wasting nore than they directly consume, leaving upon the ground large ns of what they cut, and breaking down and destroying much of ung wood in getting what they seek. Often this waste and broken wood, becoming dry, is ignited by some accidental cause and be- the occasion of a raging, uncontrollable fire, which sweeps through est, carrying destruction over a wide space. Such is the condition forests in a large portion of the country; such it has been for years. This reckless, ruinous treatment of the forests continues if any abatement, notwithstanding the warnings which have on the subject by those who have observed it with a disin- w.

tral and southern portions of the country the destruction

of the forests has not been carried to the same extent as it has been in the northern and western portions, and has not yet excited alarm. Those portions were naturally heavily wooded, and owing to their different situation and the different character of their wood have not been drawn upon, either for fuel or lumber, to the same extent as have the forests of the North. But as the northern supplies for lumber have been found, within the last few years, to be perceptibly diminishing, and their entire failure within a comparatively short time is manifestly threatened, attention has been directed to both the pine and the hard woods of the South, and the lumbermen have been transferring their operations, to a considerable extent, to that region. Large tracts of woodland have been bought up for lumbering purposes, and the same wasteful methods of cutting and use have been adopted which have so long prevailed at the North. Throughout extensive regions, where the forests have not been visibly cleared away the finest timber has been culled, and already in many of the Southern States, in portions which, to the traveler or the casual observer, seem well wooded, it is difficult to procure timber of the best class. Agents of great wood-working establishments of our own country and of Europe have visited most of the accessible forests of the South and Southwest and bought up the choicest stock of hard woods. So far has this gone that, taken in connection with the reckless consumption of these woods which has prevailed, it has carried the price up to a point which indicates their present scarcity. Black walnut, formerly so abundant as to be used freely for fuel and for fence-rails, is now quoted in the market at nearly as high a price as mahogany, and the best cherry wood is but little lower. Undoubtedly the States bordering upon the Mexican Gulf and the Lower Mississippi have an abundant forest area, much of which can be cleared and devoted to agricultural purposes with manifest advantage in every respect. But this clearing should be done judiciously and not in the hap-hazard way in which it is now going on. It is none too soon for those States to take warning from the results of the reckless destruction of forests in other parts of our own country and in European countries, and begin to husband their resources and so regulate the consumption of their woods that it shall not impair their forest capital, but leave it in such a state and so distributed that it may perpetually yield a sufficient supply for the economic uses of the people, while also exerting its proper influence in preserving a desirable climatic condition and ministering to the interests of agriculture and commerce, as forests properly situated are known to do by maintaining a desirable degree of moisture in the air and an equable flow of the streams.

INFLUENCE OF FORESTS UPON THE FLOW OF STREAMS AND UPON FLOODS AND DROUGHTS.

Whatever doubt there may be as to the direct influence of forests in the production of rain, there can be none in regard to their effect upon the distribution of the rainfall by means of springs and streams. The responses received during the year to the inquiries on this subject made by this division, confirm the conclusions arrived at by observations and inquiries which have been made from time to time in this and other countries. With one voice they attest the fact that the removal of the forests from the neighborhood of streams not only lessens the whole amount of water flowing in their channels, but renders its flow more irregular than before. In the case of the smaller streams, when the forests adjacent to them or in which they have their head-springs

e been cut off, the streams have often been so reduced as, at certain
s of the year, almost to disappear. And, in the case of streams,
ner large or small, the result has been to produce floods when the
s melt in spring-time, or after heavy rains, to be followed by a greatly
ished flow of water afterwards, especially in those seasons of the
ear when rains are least frequent and copious.

As to the direct influence of forests in producing rain or increasing
s amount in their immediate vicinity, and their consequent favorable
fect upon agriculture and the supply of water for springs and streams,
lthough the preponderance of evidence at present seems to favor the
nclusion that they have such an influence, further observation and
ful and extended experiment are necessary before this can be con-
red definitely and conclusively settled.

nardly anything, however, can be regarded as being better settled,
y extended observation, than that the forests are great regulators of the
istribution of the water precipitated from the clouds and consequently
f the flow of streams. By their shade and by the obstruction which
hey offer to sweeping winds, they lessen the evaporation which would
therwise carry off speedily from the ground much of the rainfall,
hile the loose, spongy soil, formed by the accumulation of their fallen
absorbs the water precipitated from the sky or produced by the
ng of the winter's snow, and causes it to flow off gradually into the
ls of the streams instead of being allowed to flood them at once
produce at times devastating torrents. It is a well-established fact,
ov to all whose observation reaches through any considerable
u of time, that with the clearing away of the forests to secure land
agricultural purposes or to convert them into lumber, the lesser
is have diminished in volume and the larger streams for this rea-
nave become less navigable, and therefore less available for com-

Instances might be adduced without difficulty of saw-mills
other wood-working establishments, which have been erected upon
flowing through or near forests, with the design of using the
nal near at hand, where the process of cutting away the trees has
o uminished the amount of water that the requisite power has failed,
nd the owners have been compelled to build new dams and duplicate
r machinery so as to use the diminished water-supply a second time
only means of continuing their business. The manufacturers on
y of our streams have been obliged thus to duplicate their ma-
inery, or to build reservoirs at great cost, in which to store up the
uperabundant water of flood-times for use in times of drought, or to
upplement their deficient water-power by the introduction of the aux-
iary power of steam.

Four years ago the State of New Hampshire appointed an able com-
ission to inquire into the extent to which the forests of the State were
ing destroyed, and the effect produced by their destruction upon rain-
all, ponds, and streams. This commission, after protracted and ex-
ensive inquiry, has recently made its report, which is one of great
not only for the people of New Hampshire, but for those of many
States. For the purpose of ascertaining the facts of the case the
ssion sent out circulars to the town authorities and to many others,
lly of the older inhabitants, asking them whether the amount of
n the streams, ponds, and springs in their vicinity had dimin-
within their remembrance; and, if so, whether the removal of the
nd forests had anything to do with it. From the replies to these
it is very clear that the destruction of the forests has had
cts. Among the facts reported the following may be taken

as examples of the general testimony: A small stream in the southern part of the State, in the town of Richmond, in 1865, furnished power sufficient for four saw-mills nearly all the year. It began to dry up as the cutting of the timber commenced in its vicinity, and the water and the woods now have disappeared together. In the adjoining towns o Fitzwilliam and Rindge the same results have been reached. Well known trout-streams, once well stocked with fish, are now dry one-hal of the year, the ground having become treeless. In Chesterfield th flow of the streams is reported as more irregular than in early tim The same is true of the streams about Nashua. The Merrimac Rive so important for manufacturing purposes, is protected from great vari tions in its volume from month to month, by means of large ponds a dams, but one of the oldest inhabitants of Franklin, who has observe the river for sixty years, thinks its volume has diminished one-fou in that period. One who has given much attention to the subject, confident that the water in the Contoocook River has decreased third, even within twenty years, and that its tributaries have fal still more. At Hanover, it is said the Connecticut River for many has been decreasing in volume, and with increasing rapidity the t from its headwaters has been floating by. In Canaan, sixty-five ago, there were nine or more mills; abundant water-power all the round; no thought of reservoirs, double dams, or precautions a drought. A native of the place, returning after an absence of tw years, found the hills and rocks bare, the springs choked up, and mills obliged to resort to steam-power or lie idle. Even in the northe counties, where the timber is still comparatively abundant, similar mony is given. In the town of Littleton, three of its oldest citi testify that the power of the Ammonoosuc at that point has diminis one-third within fifty or sixty years. An intelligent observer at Berl on the Androscoggin, says that the water in eight brooks and two po in his vicinity has materially diminished within twenty-six years. S years ago he supplied his stock with water from what was then an u failing brook, by means of an aqueduct, which furnished 300 gallons p hour. Now, that the trees along the stream have been destroyed by t woodman's ax and by forest fires, his water-supply is cut short in mer by drought and in winter by frost.

The geological character of New Hampshire is such that it must tinue largely a wood and timber bearing State. "Nature herself," the commissioners, "in the very configuration of the State's surface, in the character of its soil, absolutely commands that whatever may the preference of its inhabitants, at least one-half of it shall remain pe petually devoted to the production of wood and timber, and that wh nature has unalterably ordained it becomes them to accept." Accep ing this ordinance of nature, the wooded area, in limited districts, been allowed to increase, and in every instance where the decrease water-power has been checked or averted, the commissioners say th t has been by means of the preservation or restoration of the forest The regulative power of forests receives important testimony in its fav lso from the geological report of the State, from which we have tatement (vol. 1, p. 124) that when in the central and southern pa ions of the State the hay crop has been cut short by drought, it has be nown to be above the average in the northern part, even with less rai all, and for the reason that the forests secured a better distribution he results of rainfall and melted snow. In short, the proper stor nd distribution of our water-supply are of much greater importance s than the amount received

eport of the New Hampshire commissioners confirms the conclu-
careful observers everywhere in regard to the influence of forests
e volume and steadiness of the flow of streams. In Europe the
nclusions have been reached by the most scientific observers.
Herr Gustave Wex, chief director of works undertaken for im-
the Danube, published a paper in which he argued that the
ion of water in many streams was to be ascribed to the clearing
rests. He presented a series of annual observations made by
f river-gauges, from which it appeared that in the case of the
at Emmerich, from 1770 to 1835, the mean depth for the first ten
as 11 Prussian feet and 4.1 inches, and in the last ten years 6
inches. The decrease in the Elbe, the Oder, the Vistula, and
ube had also been considerable and apparently from a common
The paper excited much interest, and the author requested the
l Academy of Sciences at Vienna to appoint a commission to
its facts and statements. This was done, and after several ses-
which the commission also took into consideration the argu-
hich had been adduced to explain the facts on a different theory
at of Herr Wex, they made a report fully sustaining his views.
ject was also brought before the Royal Academy of Sciences of
rsburg, and a commission appointed, who fully confirmed the
and conclusions of Herr Wex in regard to the influence of the
of the forests upon the flow of streams.

borative evidence substantiating the opinion of Herr Wex might
ced from many European sources, as this subject has received
ore attention abroad and for a longer period than with us. One
f evidence is to be had there which we cannot yet furnish, be-
e have so lately begun to plant at all on such a scale that we can
y conclusions as to the effect of the planting upon climate or
or the flow of springs and streams. But in Europe, where ob-
ns have been made for a long time and in a scientific manner,
re great areas of ground have been planted with trees and for-
stablished in places from which they had been removed, the
e of the forests is susceptible of a double proof, which is most
e and satisfactory. More than two hundred years ago France
concerned for her forests, which were being rapidly consumed,
ious regulations were made from time to time for their conser-
Arrangements were also made, on liberal terms, for the exten-
hese regulations to the forests belonging to the communes, where
ld be done with their consent. In the *Ami des Sciences*, of De-
1873, there is given the following statement by M. Cantegril,
ector of forests:

e territory of the commune of Labruguière (Tarn) there is a forest of 1,834
4,524 acres), known as the forest of Montaut, and owned by the commune.
northward on the Montagne-Noir, and the soil is granitic, with a maximum
f 1.243 meters, and a slope of from 15 to 60 in 100. A little water-course,
n brook, rises in this forest, and drains the waters of two-thirds of its sur-
the entrance of the forest, and along this brook, are located several fulling
h requiring 8 horse-power, and moved by water-wheels, which work the
the machines.

mune of Labruguière had long been noted for its opposition to the forest
s, and the cutting of wood, together with the abuse of pasturage, had con-
forest into an immense waste, so that this great property would hardly pay
rding it and afford a meager supply for its inhabitants.

orest was thus ruined and the soil denuded the waters after each
swept down through the valley, bringing with them great quantities
débris of which still encumbers the channel of this stream. The vio-
floods was sometimes so great that they were compelled to stop the
time. But in the summer time another inconvenience made its

appearance. Little by little the drought extended, the flow of waters became insignificant, the mills stood idle or could be run only occasionally for a short time.

About 1840 the municipal authorities began to give information to the popula relative to their true interests, and under the protection of a better supervision work of replanting has been well managed, and the forest is to-day in succ growth.

In proportion as the replanting progressed, the precarious use of the mills ceased and the region of the water-courses was greatly modified. They now no longe swelled into sudden and violent floods, compelling the machines to stop, but the ris did not begin until six or eight hours after the rains began. They rose steadily t their maximum, and then subsided in the same manner. In short, the mills were n longer obliged to stop work, and the water was always enough to run two fulling ma chines, and sometimes three.

This example is remarkable in this, that all the other circumstances had remaine the same, and therefore we can only attribute to the reforesting the changes tha occurred, namely, diminution of the flood at the time of rain and an increase of it flow during other times.

EFFECT OF FORESTS UPON CLIMATE.

As to the influence of forests upon climate the replies to the circu lars are less satisfactory and of less value than they are in regard to effect of forests upon the flow of streams, as might have been expecte It requires a nicer and more methodical observation to ascertain former than the latter. The shrinkage of streams and the alterna of flood and drought are obvious to all who dwell near them, whether the are intelligent enough to assign the proper causes of them or not. Th occasional testimony of the eye is all-sufficient. But it is only a highe order of observers who are competent to give testimony as to variation of climate and the extent to which such variations should be ascribe to one cause or another. We shall have to wait, therefore, until we hav such observers in sufficient number and they have extended their ob servations over a sufficient length of time to eliminate errors which attach to particular instances before we shall have a body of evide which will be generally accepted as conclusive. Meantime we must de pend upon the results of the observations which have been made b competent persons in other countries where the study of forestry long been prosecuted and is not a novelty of the day. We have s truly scientific observers in regard to this as well as other subject They are doing useful work. But we need many more for the wide ex panse of our country, not only in connection with our colleges and s entific academies, but in all our cities and larger, not to say smalle towns. It is only by the careful comparison of a multitude of such ob servations, reaching through many years, that we can arrive at sa factory conclusions. No agricultural college at this day should be re garded as doing its proper work, or as worthy of the name it bear which has not a chair for instruction in forestry, in connection wit which systematic observations in regard to the influence of forests upo climate are made.

EXTENT AND SUCCESS OF TREE PLANTING.

Returns from the circulars making inquiry on the subject show gratifying increase of interest in the subject of tree planting. A night be expected, this awakened interest is most general and wide extended in those Western States and Territories where the natural su ply of trees is most deficient. In Nebraska, with the helpful stimu of Arbor Day, which had its origin there, it is reported that 7,000, trees were planted in a single year and on a given day, and already t

er of acres of planted forest in that State exceeds that of the ıtural forest. In Kansas and Dakota a similar interest is manifested. innesota has shown for several years a most intelligent interest in ee culture. The *Forest-Tree Planter's Manual*, published by the State orestry Association, contains much valuable information on the sub- ct of tree planting, and its distribution has been of much service not ; in Minnesota, but also in other States.

Letters received by the division from all portions of the country in- te that there is an awakening of interest in tree planting in every irection. Of course, it results as yet in the planting of an insignifi- amount, when compared with the vast quantity of native forest lly swept away by the ax and by fire. But such interest, once ed, grows in intensity and spreads from one to another. The more ention is given to the subject the more interesting it becomes. The e one plants the more he wishes to plant, and his example stimu- s his more ignorant or tardy neighbor to adopt a similar course and ıe a tree planter. More and more a knowledge of the offices of ees in respect to climate and its modification, in respect to the growth f husbandman's crops and the comfort and pleasure of life, is abroad and gives promise of a coming time, not far distant, the value of trees will be generally recognized, and they will be eated accordingly.

That tree planting has been attended with failure in some cases is not denied. The reports coming to the division indicate this, and some isposed to assert that tree planting is so seldom attended with suc- ıs to be discouraging. But when it is considered that many of who engage in tree planting have had little or no experience in ıg and as little knowledge of the laws which govern plant life, so little attention is given to the choice of trees or their adaptations ifferent soils and situations, and that so little care is given to the act ıting itself, and so little subsequently, the wonder should be that nany, rather than that so few, trees when planted live and thrive. The almost uniform testimony is that the failure of trees to grow is butable to the lack of proper preparation of the ground, carelessness lanting, or insufficient attention afterwards. While it is true that s will flourish on poor soils, and where the ordinary crops of the would fail, and while on this account there would be great gain oting much of our sterile and so-called waste land to the growth rees, it is yet as true in regard to trees as it is in regard to other ble growths, that the better the soil the better the crop, and that will pay to be careful and painstaking in the cultivation of the corn or the cotton, it will as surely do so in the case of the maple or the ut.

Many persons, from their mode of treating trees, would seem to think the planting of a tree requires no other care than is requisite for etting of a post. They actually expend more time and care often setting of a post, which they expect to last but a few years at the than they do in planting an oak or an elm, which has in it the pos- y of growth and constantly increasing value for hundreds of years. ost is dead matter; the tree is a living thing, endowed with a deli- anism, sensitive to whatever it is in contact with and to all its dings. In the case of the former, care is usually taken to place ground at the proper depth and to see that the earth is com- ound it on every side, so that it will stand firmly in its place. tree, how often is the planter careless whether the earth is to a sufficient depth and width to admit its roots and allc

them to be placed in their natural position, or to press it properly about the roots so that they may hold the tree firmly in place and at the same time allow their delicate fibrils to lay hold of the food upon which the life and growth of the plant are dependent. Then, again, how often is it taken for granted that the tree, once placed in the ground, will take care of itself and grow without any further attention. So the tree planter allows the grass and weeds to spring up around his young trees and absorb the nutriment which they ought to have, and then wonders that the tender trees wither and die. Failures in tree planting are attributable to ignorance and carelessness. The intelligent and careful planter does not often complain of failure. The late Leonard B. Hodges, superintendent of tree planting on the Saint Paul and Pacific Railroad, and well known for his interest and success in forest-tree planting, says: "I suppose that portion of the treeless region of Minnesota, which is intersected by the main line of the first division, Saint Paul and Pacific Railroad, is a fair average of the treeless region of Minnesota, no better and no worse. Now, my experience in this work on that range of country enables me to say with considerable confidence that I can figure closely on the cost of growing 40 acres of forest timber out there as any farmer can on the cost of growing 40 acres of wheat or of corn. I might truly say, with more certainty, for there is less risk in raising a crop of forest trees." And again he lays it down as true, and challenges contradiction, that a crop of trees can be grown as surely and in proportion to its value with far less expense than a crop of corn. With anything like the attention bestowed upon trees which most persons are ready to bestow upon their annual crops the labor of the tree planter will be crowned with success.

DISTRIBUTION OF TREE SEEDS.

During the year several hundred packages of tree seeds, embracing thirty or more varieties have been distributed in various parts of the country, chiefly in those regions which are most destitute of trees. As it is not possible for the Department, with the means at its disposal, to undertake to furnish trees or seeds of trees on a large scale and in quantities to meet the demands of forest planters. Nor would it be desirable to do so, perhaps, if it could. If done at all, it should be done by the separate States, as it is done in some of the countries of Europe where seeds and trees are given to the planter or sold at cost, as an inducement to him to plant. All that the General Government can do is to furnish seeds in small amounts for the purpose of experiment to test their adaptation to particular soils and climates. This it can properly do, and the results of experiments thus made should have a beneficial effect in promoting sylviculture. If the Department had grounds of sufficient extent to enable it to plant tree seeds and cultivate them, it might be well to send out trees in small quantities to be tested as to their adaptation to various localities.

A NATIONAL ARBORETUM.

There ought to be at this seat of General Government an arboretum and experiment station where the visitor could see specimens of all of native trees that will flourish in this latitude, and also all desirable foreign trees. It should be a grand botanical garden in the largest and best sense, where careful experiments should be made from year to year in all that pertains to the character and growth of trees, and from which

; be sent out from time to time specimens to be tested in other lo-
es. No work of the Government would be more legitimate than
f providing such a place. None would be more serviceable to the
. In connection with similar gardens and experiment stations
several States, working with a common method and for a com-
purpose, interchanging seeds and trees, and distributing them
ghout the country, most valuable knowledge would be constantly
l, many of the arts and industries greatly benefited, losses avoided,
ie prosperity of the people promoted.

THE AMERICAN FORESTRY CONGRESS.

e the organization of the American Forestry Congress in 1882, the
tment of Agriculture has recognized it as being engaged in the
work as its forestry division and has given it its sympathy and aid.
f the sessions of the congress has been held, by invitation, at the
tment. At the annual meeting of the congress at Boston, in Sep-
r last, the Department was represented by the Commissioner, who
an address in behalf of forestry, and by the chief of the divis-
ho read several papers and presented a chart, which had been
red with much care, showing the comparative areas of forest,
and waste lands in the several States and Territories. A reduced
of the chart is here presented in connection with this report.
approximation only can be made as to the precise areas that may
garded as forest, but no pains have been spared in seeking the
trustworthy sources of information on the subject, and it is be-
that the figures here given represent more nearly than any else-
available the present state of the national domain as to the ex-
f its forests.

SOUTHERN FORESTRY CONGRESS.

orestry congress of the Southern States has been held recently in
la, which was well attended by delegates from those States and
ny others. The Department contributed what it could in aid of
ngress, being represented there personally by this division. A
ittee from the American Forestry Congress were also present,
; what assistance they could by reading valuable papers and
vise. Governor Perry, of Florida, was very active in promoting
terests of the congress, and at the opening session delivered a
arnest address in behalf of the congress and its work. The meet-
' the congress continued during three days. Abundant evidence
iven during the proceedings that many in the South are already
le of the rapid and wasteful destruction of their forests and of
ed of taking measures for their protection and preservation. Very
s inroads have been made already upon these forests, and the
st source of wealth to the Southern States is being sacrificed
it any adequate return. The turpentine industry is prosecuted in
manner that, while ruinous to the pine forests, it yields but a
r compensation for the labor and capital employed, and in the
competition with which the production of lumber is carried on,
kets are greatly overstocked and the product is sold, in many
or less than its actual cost.

valent custom of allowing cattle and swine to range in the
of very great detriment to them, destroying, as it does, to a
t, the young growth, and thus preventing a succession of

trees when those now occupying the ground shall be removed. The present indulgence will be dearly paid for in the future.

Happily the Southern States are so amply stocked with timber of valuable quality, having 50 per cent. of their area clothed more or less densely with trees, that if the facts brought to view at the recent congress are properly set before the people of those States there is reasonable ground to think that the destruction of the forests may be arrested before it shall have gone so far as to imperil hopelessly the great interests of the country.

TREE PLANTING BY RAILROAD COMPANIES.

In view of the great and constantly increasing demands made upon the forests by the railroad companies for the supply of ties and other material for their use, it has become an important question whether those companies should not plant trees along their roadway, or on tracts of land adapted to the purpose, in sufficient quantity to supply all their needs, thus greatly benefiting themselves while at the same time relieving the existing forests from an onerous demand which is now made upon them. The land-grant companies have an abundance of land either already covered with trees or which might be planted so as to furnish them, with proper care, a perpetual supply of timber, and the and other companies, by planting belts of trees along their lines, ... not only provide themselves with all the timber needed by the ... could at the same time protect their tracks from that great impediment to locomotion, drifting snows; and from the fierce winds, which are a source of much discomfort to travelers. The superintendent of one our Western roads informed me that the expense of clearing its t from snow during a single winter was far more than would have b the expense of planting trees along its whole line. One of the W... railroad companies was induced, a few years ago, to make the experiment of tree planting. A single section of land was planted with catalpa and ailanthus. It has been attended with complete succe... have the testimony of officers of the road and of those who were employed in planting that there are now 2,000 or more healthy and thrifty growing trees on each of the 640 acres planted. The estimates of officers of the road in regard to the cost of the whole operation, continued until such time as the trees will have attained a proper size to yielding ties, and which are appended to this report, make it one of decided economy as compared with the purchase of ties as usually practiced. There would seem to be no reason to doubt the feasibility of similar undertakings on the part of other roads, and the agents of division have been instructed to present this subject to the consideration of the railroad companies so far as possible.

Mr. M. G. Kern, an agent of this Department, made inquiry of general manager of the Kansas City, Fort Scott and Gulf Railroad Company, Mr. George W. Nettleton, relative to success of its tree-planting experiments at Farlington, Kans., and received in answer the following statement:

> You ask if it is my judgment that the money expended by this company in the Farlington tree plantation will prove profitable as an investment. In reply I will say that the trees have now reached such a size that a pretty close estimate can be made as to their outcome, and I respectfully submit the following:
>
> six hundred and forty acres were set apart for planting, worth $6,400 00
> The cost of fencing was 2,400 00
>
> 8,

planting 512 acres (unplanted portions of the tract were not or trees) with 2,600 trees per acre, and the care of them for was $30 per acre, or for 512 acres	15,360 00
first cost	24,160 00
interest, compounded at 7 per cent. for twelve years on cost f land and fencing	10,912 00
cost of trees planted ($15,360) compounded at 7 per cent. for s	11,059 00
relve years	1,200 00
ıtation for eight years	6,480 00
ed total cost of plantation at the end of twelve years	53,811 00

e cost of the trees per acre at the end of twelve years will be $105.10, roperly be reduced by the value of the land after the trees have been were planted about 2,600 trees per acre, and at the end of twelve years of sufficient size to yield 3,000 fence posts per acre, worth at present ıts each, or $450 per acre. Already the growth of the trees is sufficient this estimate of yield. The catalpa (*Speciosa*), the kind of tree planted lington plantation, is easily propagated, rapid in growth, and is well ts durability when exposed to moisture, which quality makes it especially fence posts and railroad ties. The reports of Mr. R. Douglas, of Wau- who planted the trees, and of Mr. G. C. Brackett, who is secretary of the e Horticultural Society, in regard to their present condition, copies of ıave, give information which I will not take the time to duplicate.

ert Douglas makes the following report of results of his work nting, for the above-named railroad company, under date of r 30, 1885:

spectfully report that the contract of Robert Douglas & Sons for planting ing the tree-section at Farlington, Kans., is now completed.
er of trees planted and cultivated are as follows:

d six years	57.50
d five years	76.67
d four years	106.00
d four years	9.50
d three years	104.00
d three years	76.00
d three years	14.20
	443.87

l over to the company in—

	Acres.
	100
	75
	200
	375

3.87 acres now ready to be turned over.
the trees now, and circumference of the stem near the ground:

	Age.	Height.	Circumference.
	Years.	*Feet.*	*Inches.*
sa	6	18 to 21	12 to 18
	5	12 17	10 16
	4	8 14	8 12
	3	5 10	6 9
	6	16 18	10 15
	3	12 17	10 13
	3	6 10	6 9

he height in general, but there are spots of "gumbo" or alkali soil ly the surface soil has been removed at some previous time, on which stunted growth. Fortunately, however, there is very little of this soil we have planted, so that there is not an acre planted by us that will

fall short of the number of trees required to fill the contract; and probably not 5 acres in all our planting on which there are not from 2,500 to 2,600 trees. Our contract calls for 2,000 trees to the acre.

The forest is in a very healthy and thrifty condition, and is in every way very promising for the future.

As forestry in this country is yet in its infancy, and nearly every one who has given it but a passing thought has a theory of his own, and as several parties have come to examine the plantation, and in nearly every instance have contented themselves by riding around the forest roads, even without getting out of the carriage and walking among the trees, and as a majority of these visitors have strongly recommended the pruning of the trees, I would here urgently caution the company, so that they will not be led into the great mistake and very expensive experiment of pruning these trees. They were planted closely to avoid the necessity of pruning. The trees will prune each other. Even the trees but six years planted are now 20 feet high on the best land, and have their side branches smothered and dead up to over half their height, so that it would be a great waste of time, if nothing worse, to prune them the first 10 feet from the bottom; and it must be apparent to any one that it would be costly to prune them up to the next 10 feet, but in three more years the next 10 feet will be pruned by the same process as the first 10 feet.

The side branches are a great advantage to the trees, support the trunk, fill and shade the space between the trees, shading out the weeds, and retaining the moisture.

These trees are making height so fast that by measurement we found leading shoots of some of the three-year old trees over 6 feet long, and shoots from some of the four year old trees 7 feet long, showing that they need all their side branches to support the stem; and it may be noticed that trees with the most and strongest side branches are the strongest and the tallest.

It is true that to an ordinary observer looking in among the trees, the dead lower branches will have a ragged appearance, and aside from this, there will be some misshapen and crooked trees: but these are better standing than if removed, as they afford shade for the trunks of the adjoining trees. They cost the company nothing, and there are over 2,000 perfect trees to the acre without them.

There will always be cull-trees, even in the nursery, and such trees, with the best of pruning, will still be culls. I would not be understood as offering the foregoing remarks as an apology—very far from it—as it is a surprising success. This plantation is on a larger scale than any other in the country (unless it be the one nearly adjoining that we lately planted for Mr. Hunnewell), and I would most urgently advise that the trees be allowed to stand undisturbed, except to trim up the outside row, where branches extend out into the forest roads, which is already the case with the plantings, until the first planting is at least ten or twelve years old; but in the meantime, if fence-posts be required within the time, they can be thinned out as wanted without damage to the plantation.

If trees are required for planting at any of the stations on the company's road, or for parks or other purposes, thousands can be taken out of the three-year old trees near the section-house without injury to the plantation; and they are now of the very best size and condition for that purpose.

I would suggest that if any are required for such purpose, an experienced man should be employed to see to the proper digging and planting, as this would not only be the most successful but the most economical way the work could be done.

Mr. Douglas makes the following supplementary report:

	Age.	Height.	Circumference near the ground
	Years.	*Feet.*	*Inches*
Catalpa	7	20 to 24	14 to
Black walnut	7	*4 16	9
Black cherry	6	10 18	
White ash	7 or 8	*4 17	
Box elder	7 8	12 18	
Butternut	7 8	*8 16	
Osage orange	7 8	8 17	10
Pecan	7 8	*4 8	.....

* Uneven.

Owing to the very wet season probably the white ash, the black walnut, and but trees have held their leaves well and made a much stronger growth than before

The secretary of the Kansas State Horticultural Society, Mr. G. C. Brackett, also made an examination of the forest-tree plantation at Farlington, Kans., and made report as follows to Mr. Nettleton, under date of September 10, 1885:

CATALPA SPECIOSA, WESTERN HARDY.

(1) I found the block of three years old in a compact form and with very few failures in the original planting. The growth of these has been remarkably vigorous and shows every evidence of health and a well-shaped body to make a well-formed tree for timber purposes. Many of these measured 3 to 3½ inches in diameter and 6 to 0 feet in height, and a current year's center growth of nearly 7 feet in length and very stocky.

(2) The block of four years old was fully equal in every respect to the first, considering the age.

(3) The blocks of six and seven years' growth will compare favorably with the first and second, many of which measure from 5 to 8 inches in diameter and 15 to 22 feet in height, with finely-formed bodies. The uniform growth and apparent healthfulness is remarkable, being planted, as they are, on an exposed prairie, with no shelter or protection other than what their own growth would afford. In these we have the gratifying evidence of the adaptability of this species to the climate and soil of prairie regions as a forest tree. The present compact form of these blocks also shows an unusual success by the few failures in the original number used in the plantation. Another point of great interest, not only in these blocks, but in the entire plantation, is uncommon evenness of growth of the different ages, which certainly reflects great t to the intelligence of the management. The slight variations in so remarkably instances are evidently the result of varying soil, and to avoid which would have been impracticable, either by care in planting or after management, except by special measures, and would have been a questionable matter as to the profitableness of such an undertaking.

AILANTHUS GLANDULOSA.

This tree is generally used on stony points, thin soils, and on the breaks of ravines with good results. In such locations its most valuable character of wood is obtained, as when grown on rich or bottom lands, the wood becomes worthless, its durability texture is largely lost. This fact seems to have been fully recognized by the of the Farlington forests.

block of six years' growth of this tree already presents a fine forest appearance, trees measuring from 5 to 8 inches in diameter and fully 15 to 18 feet in height, straight, smooth, and well-formed bodies. There are but very few failures in the original planting among these.

The younger blocks are equally promising, and demonstrate the usefulness of the hus for exceptional soils on which scarcely any other valuable sort could be sfully grown.

whole area of this artificial forest shows a remarkable success, and, I venture sertion, has no equal in the United States, considering its magnitude, and I was most agreeably surprised to find a work of such proportion as fully a success as that of any small plantation within my knowledge. It will stand any reasonable criticism without suffering in the least, and should give entire satisfaction to all concerned.

While this undertaking evidently was considered from the point of a paying investment by the parties interested, it has resulted in great benefit to the forestry interest of Kansas. It has demonstrated practically the possibilities of our prairie lands to produce forest trees of at least a very promising character to supply the future timber product required for railway ties, construction work, and many other purposes in which a durable character of wood is needed, and for this alone our citizens should feel under obligations to your company. I have endeavored to present to you a fair and reliable statement, closely following the facts obtained by personal examination, and judging this work from a practical knowledge of forest-tree growth in other portions of our State and as found in other prairie States to the north and east of Kansas.

FOREST FIRES OCCASIONED BY LOCOMOTIVES.

In this connection the occurrence of forest fires occasioned by sparks motives and their possible prevention properly comes up for tion. From careful inquiry made in preparing the last cen- appears that about one-fourth of the forest fires in the census

year were occasioned by sparks from locomotives. The va
erty destroyed by the forest fires was estimated to be
$25,000,000. The proportion of this loss which was oc
sparks from locomotives is not estimated in the census retu
loss thus suffered is too great to be borne without making
able efforts for its prevention or at least its great mitigation.
at present existing which have for their professed object
tion of fires occasioned in this way are very inefficient. Tl
ous contrivances for the consumption or arrest of locomo
Some of these are pronounced by railroad officers and en
satisfactory in completely attaining their object, while at th
they can be attached to any engine at comparatively little e
in the case of some of them their use is said to be at
diminished consumption of fuel for the same service. I
seem to be no sufficient reason, therefore, why all railroad
should not be required by law to provide their locomoti
cient spark arresters.

TIMBER THIEVES ON PUBLIC LANDS.

Vast quantities of timber continue to be stolen from land
to the United States; and there is reason to believe that
destitute of respectability are in collusion with the thieves.
tions of railroads are now being furnished with ties and br
taken, it is said, from the public lands without any w
right, and without any compensation. This division has been
such depredations repeatedly, and has done what it could t
by making the facts known to the Commissioner of the
the only functionary who is authorized to prosecute such o

MONTANA RESERVATION.

It is much to be regretted that the bill introduced into th
Mr. Edmunds, for the permanent reservation of a forest t
tana, near the headwaters of the Missouri and Columbia Ri
make its passage through the House of Representatives an
law, thus providing for all time a regulator of those import
besides securing other advantages.

SUSPENSION OF SALE OF TIMBER LANDS.

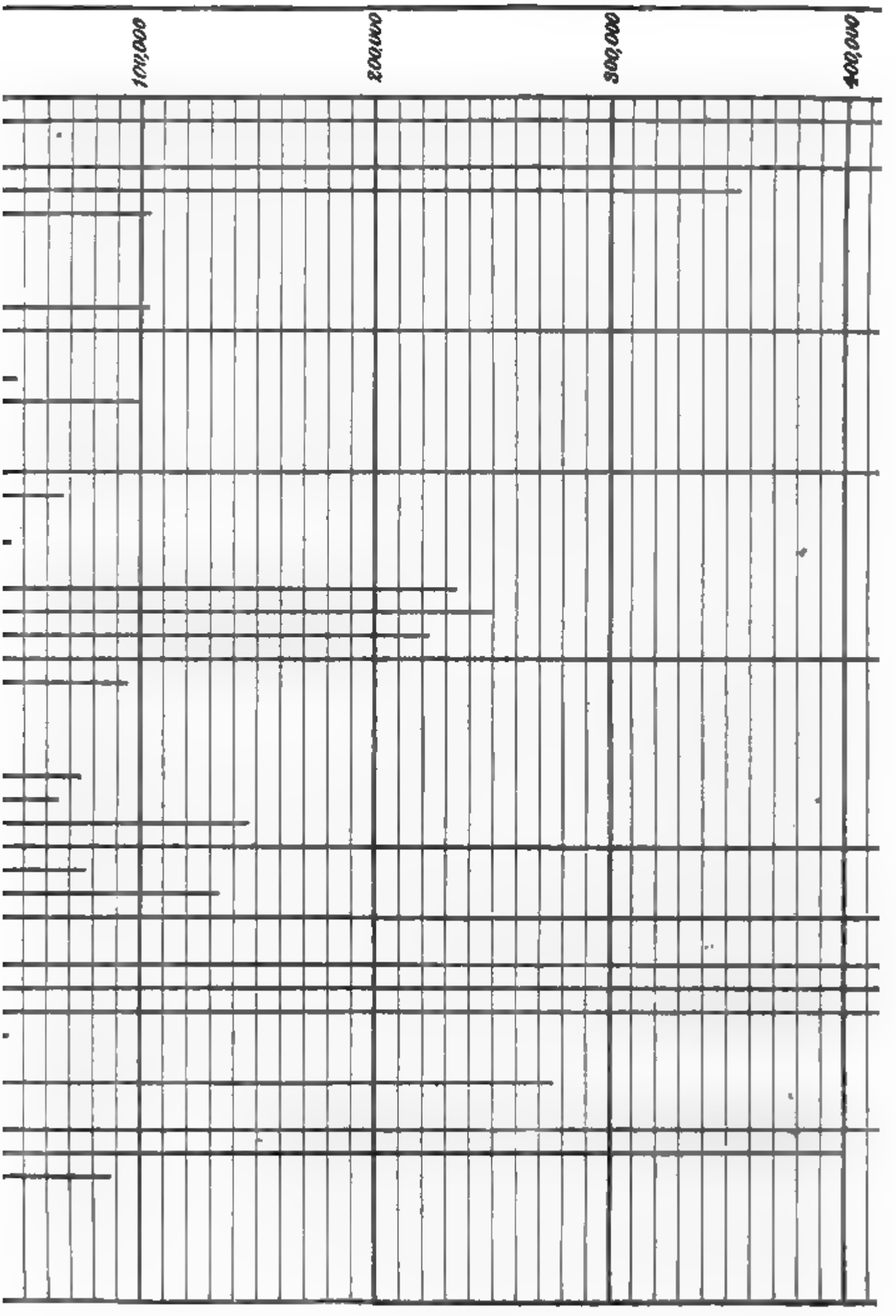
In view of the continued destruction of the timber on the G
lands, and the greater importance of preserving for perm
tion and use such portions of forests as are adjacent to t
of rivers, or which may be needed for climatic or other r
nected with the general welfare, I repeat my conviction
public policy demands that the further sale of timber lands
to the United States ought to be suspended, until a careful
ascertain what portion of them may be disposed of witho
the country and what ought to be held permanently in a
lition

ENCOURAGING PROGRESS.

The review of the year is encouraging. The interest in t
forestry has increased throughout the country. The publi
department by themselves and yet more as they have been

Diagram showing t

[The li bt perpendicul



Cor

or in part by our numerous newspapers, together with the dis-
which have taken place in agricultural and other conventions;
ended the knowledge of the subject, and it is one which only
be known to awaken interest, for it is seen at once to be one of
portance to the country, bearing as it does so manifestly upon
rts, industries, and occupations of life.

ablishment of Arbor Day, or tree-planting day, already adopted
n of our States and Territories, is one of the most encouraging
the advancement of forestry. The extension of the observance
day throughout the country should be urged by every proper
ation. Its general establishment would be among the most
means of creating a proper sentiment in regard to trees and
equate protection.

stablishment of Arbor Day should enlist the children as well as
n its observance. While the principles and practice of forestry
e taught with scientific completeness and precision in our agri-
and other colleges and experiment stations, the pupils in our
schools should be taught the elements at least of vegetable
gy, though in a simple and untechnical manner. They may
encouraged to plant trees and flowering shrubs around the
ouse and in its vicinity. They can easily be led to watch their
and so doing, they will become interested in them and be ready
ct them. Becoming interested in these, which will seem to be
sense their own, they will soon be interested in other trees, com-
hem one with another and noting their points of agreement and
e, especially if the helpful guidance of a teacher is given them.
ll thus be led in a most pleasant way into the observation and
natural objects, than which there is no more useful study, and
ay we might hope to have soon a generation who will be tree
rs instead of destroyers. In some European countries the law
every school-house to be so situated and to have such a space
d connected with it as to admit of the planting of a grove of
out it. Why should not our legislation be as wise?

ith the encouragement we have from an increased knowledge
wakened interest, and hopeful as the prospect seems to be, the
our forests goes on still with little if any abatement, except
mplete exhaustion makes further destruction impossible. Little,
ing, has yet been done to check the annual destruction by fires
often ravage our woodlands. The ax of the lumberman is also
ed. As the trees in one region are swept away, the virgin for-
nother are invaded by an army of ax-men, which carries destruc-
ore it. Although the lumber market is now overstocked, the
t is that more trees will be felled during the present winter than
t during the last one.

consideration, therefore, urges us to engage in the work of
nting, and to do what we can to prevent the unnecessary de-
n of our existing forests. The great interests of agriculture,
ctures, and commerce call for such action. The health and
of the people call for it. True economy also calls for it, and
her looked at in the large view and with reference to the gen-
or to the interest of the individual. The cultivation of
almost everywhere, one of the surest sources of income. There
y tracts of land in all parts of the country, even in the prairie
and the rich river valleys, which can be made so useful and prof-
o other way as by devoting them to the growth of trees. To
from the incursions of animals is sufficient, often, to con-

vert them into forests by natural growth. Seedlings are now offered for sale by numerous tree-cultivators at such prices that the cost to the planter is insignificant. A few years of cultivation, with the ground properly prepared and the trees set closely together, will secure such a growth as will shade the ground, prevent the springing up of weeds, and obviate the need of further care. The trees will grow while the planter sleeps or is engaged in his ordinary work. The thinnings required from time to time to give the expanding trees the needful room for best development will amply repay all cost of planting and care, and the grove or forest, once established, may be a source of steady and perpetual income. The facts so abundantly set forth in the reports of many of our horticultural and agricultural societies, as well as those attested on every hand, leave no doubt as to the feasibility and profitableness of tree-planting wherever it has been engaged in judiciously.

N. H. EGLESTON,
Chief of Division of Forestry.

Hon. NORMAN J. COLMAN,
Commissioner.

PORT OF THE ENTOMOLOGIST.

INTRODUCTION.

ıave the honor to present herewith my annual report for the
and take the liberty in doing so, not only to call attention to
ıe subjects of which it treats, but also to briefly review the
he Division during the year, with a view of pointing out
may in the future be facilitated and improved.

eport of work in silk culture will be found some statements as
tribution of mulberry trees and the distribution of eggs. I
discussed the question of home-raised *vs.* imported eggs. Up
sent year the Department has been in the habit of purchas-
tribution eggs from abroad which could be guaranteed as
· the simple reason that there were no persons engaged in
gs in this country who were competent to apply the Pasteur
o as to guarantee their freedom from *pébrine.* A great many
s, however, were made against this course, and it was charac-
unpatriotic. Hence the present year we have obtained all the
ed for distribution next year from home raisers. The ex-
of these eggs has entailed a vast amount of additional labor,
of a minute microscopic character requiring great care, so that
ıave really cost us a great deal more than they would have
:chased from abroad. More dissatisfaction has resulted from
pt to secure eggs from our own raisers than from the other
r a number of parties who have sent on eggs, expecting to be
ıem, have had them returned because they were found to be
, and in all such instances the parties have suffered keen dis-
ınt: hence I seriously doubt whether it is best to pursue this
the future.

of the great precaution necessary in disseminating sound
ve deemed it desirable to devote some space, not only to the
ı of this matter, but to the proper means of wintering the
great many of our correspondents who have received eggs
y lost them from premature hatching or other causes. In
e importance of the subject I have also devoted some space
chief diseases that affect silk-worms, viz, *pébrine* and *flach-*
ining the symptoms and nature of, as well as the treatment for,
ll knowledge and experience on these points are very essen-
ɔessful silk-raising, and I find that the want of information
ubject is very general.

ır all, the chief question that will be asked and is being asked
to silk culture is, "Can it be made profitable, and to what
ı efforts now being made by the Department likely to es-
ustry on a firm basis?" It is not necessary that I should

repeat here the arguments that have been set forth in former reports or in my Manual on the Silk Worm, a revised edition of which is in preparation.

In your report to the President you have well stated the requirements essential to the permanent establishment of this industry, and it is evident to all who have given the subject attention that a home market for the cocoons (and this means the successful and profitable running of filatures) is the *sine qua non* of successful silk culture. Whatever the advantages of, or inducements to, silk culture may be, it cannot be denied that the industry will never become important so long as there is little or no profit in it, and the experience of the Division is that the larger number of those who apply for information and assistance and for eggs abandon their efforts after the first year, because of disappointment and discouragement. I would, therefore, more particularly call attention to the statements of cost of production at Philadelphia and New Orleans, under the patronage and with the assistance of the Department. It will be seen that the outcome is not very encouraging, even omitting the items of office expenses, rent, interest on and repairs of plant, and cost of steam power, which do not enter into these estimates. It should be remembered, however, that it is only in the operation of a filature of considerable size that profit is attainable. Where the unproductive expenses above mentioned form a large proportion of the total cost running the establishment, as in the New Orleans experiment, the results obtained cannot be otherwise than deceiving. It is worthy of observation, also, that the price of reeled silk has greatly advanced since the calculations were made, so that with prices quoted, at this writing, the loss would be much less.

It is more than probable that no decisive results will be reached until a filature of at least twelve basins of Serrell's automatic reeler can be erected at some point where the details can be watched and controlled by myself and assistants, and conducted for at least two years on strictly business principles. Though such an establishment might be unproductive of profit, it would at least enable me to discover and point more satisfactorily than heretofore the precise difficulties in the way of profitable reeling in the United States. These features could be thoroughly studied and it would then be seen whether they were of such a nature that they could be bettered by time and experience, or such as are unavoidable under the conditions of labor found in our country. I question the wisdom of expending money in continuing such work as has been performed during the past year. It has been productive of but one great good, and that is the formation of a partial market for American cocoons.

But this market is in its very nature artificial; *i. e.*, it will cease to exist when the support of the Government is withdrawn. One difficulty that I have had in carrying on the experiments on a thorough business basis lies in the fact that while the Government can expend in experimentation and salaries and plant, the statutes prevent the utilization of whatever income results from the reeled product. Unless, therefore, the Serrell reel be thoroughly tried, it were best for the Department to leave the filature problem to private enterprise and devote its efforts to those scientific problems involved in the work, and to the dissemination of information, silk-worm eggs, &c., as has been the custom in the past. In other words, the Division should become a center or school of information and experiment in all directions that might lead to increased knowledge in reference to the industry a

pply a constant demand, which will continue whether silk cult- ads and becomes profitable or not. The business side of the would then find normal development. Finally, the experience ast two years confirms the views expressed as to the difficulty anently establishing silk culture so long as our tariff laws are it. Any stimulus given to it must needs be temporary, and tantial way of encouraging the industry is by imposing an im- y on the reeled silk from foreign countries. This is essentially which I expressed a year ago in the following words:

fifteen years, now, I have carefully watched all that has been d have, in my feeble way, aided to promote the industry, and n one effort after another to establish it on anything like an e scale fail, and always for the reason that capital and ordinary n find more profitable employment. In studying the status of stry in South France the past summer, I was also surprised t languishing and, as Professor Maillot, who has charge of the ral station at Montpellier, assured me, for the same reason ad hitherto failed with us, viz., inability to compete with the silk d by the cheaper labor of other countries, and especially of nd Japan. If the French silk-grower cannot well cope with this tion with the price of ordinary labor at 3 francs for men and 1½ r women, how can we expect to? The chief hope, in addition lvantages we possess, as set forth in the preface to the second f my manual, is in the Serrell reeling machine, which, if it fulfil nt promises, will revolutionize the silk industry and greatly ate the question of labor. It is in this direction, then, that hope, and fuller consideration of it will be found in the report."

r far the Serrell machine may be looked to for overcoming our es on the present basis of importation of the reeled silk will be t forth in the present report.

g the year destructive locusts have attracted an unusual share ion, and I have devoted some time to their consideration. The California has been due to a species (*Melanoplus devastator*) not known to be particularly injurious, and one closely allied ocky Mountain species (*Melanoplus spretus*). Both of these will treated of in the following pages, as also the non-migratory which have been extensively abundant during the year. The was sufficiently important to justify special investigation, and D. W. Coquillett, Lawrence Bruner, and Albert Koebele were gaged to make such investigations whether in California or in hwestern States. Their reports are included.

g the other events that have been prominent during the year in entomology are the ravages to onions of the Dark-sided Cut- *grotis messoria*) around Goshen, N. Y.; the injury to leather ts d shoes by the "Leather-beetle" (*Dermestes vulpinus*); the injury to most garden vegetables and to corn and cotton by ien Web-worm (*Eurycreon rantalis*); the local injury to straw- n Long Island by the Strawberry Weevil (*Anthonomus muscu-* at Meriden, Conn., of the Pear Midge (*Diplosis nigra*). This last- species furnishes a good illustration of an insect evidently re- roduced and yet confined to a very restricted area. In view of loss which such introduced insects have occasioned in the last years in different parts of the country, and the way in which spr from their points of introduction, it is greatly to be ine Department has not some means of stamping out such m duced pest, and of thus preventing its spread over the

whole country. The case is parallel to that of a localized contagious disease among animals, and I would recommend it to your careful consideration.

Several other subjects are treated of in the Report, but no insect occupied quite so much attention during the year as the Periodical Cicada. Two extensive broods of this insect appeared, and in view of the interest in the subject I have thought it worth while to discuss it at some length. I have, therefore, under various subheads, given some statements of well-known facts, together with a number of observations and some experiments unrecorded prior to the present year. I would especially call the attention of the reader to the map illustrating the distribution of the two broods and to the summary of the chronological history of all the different broods known, and will be thankful for any data from any correspondent in reference to the same.

On the whole the season has been one of marked activity in cer special directions, and the routine work of the Division has greatly creased. The amount of the routine work may be gathered from the that over 7,500 letters have been received and answered during the y exclusive of answers to circulars sent out. Some new lines of inve gation have also been begun. Chief among these is that pertaining w economic ornithology.

The work of this Division touches intimately on various other branche of zoölogy, but on none more than on ornithology. Few injurious insect can be well and fully considered without reference to their liability t be devoured by various natural enemies, and especially birds. The in terrelation between birds and insects is a theme which necessarily in ests any one who fully appreciates all the bearings of applied entom and I have for some time desired to take up the subject as part o work of the Division. How complicated these relations are is rendere obvious by the excellent work done in this line by Prof. S. A. For State entomologist of Illinois, and by Mr. F. H. King, in his report economic relations of Wisconsin birds, made under the direction of u geologist of Wisconsin.

Hitherto these investigations have been undertaken either by privat individuals or under State aid. Last winter the American Ornitholo gists' Union, a body organized some two years ago, petitioned Congr to appropriate means for such investigations by the National Govern ment, and an appropriation of $5,000 was finally obtained, and this Di vision charged with carrying on the investigation. The chief inter which the farming community has in this work is in reference to tu food-habits of birds, though the inquiry will cover all questions of a economic nature relating to North American ornithology, and especiall bird migrations and geographic distribution. In planning the work have taken charge of that part relating to food-habits, because of it intimate entomological bearings; while Dr. C. Hart Merriam, aided b Dr. A. K. Fisher, will take charge of all the other phases of the inquir

For the last two years the American Ornithologists' Union has mad bird migration and geographic distribution the subject of special inve igation, and has secured the voluntary services of some fourteen hu dred observers. Dr. Merriam, as secretary of the Union and chair of the committee on migrations, has been able to secure the services o large number of these observers in the Department work. Much is th gained by co-operating with said Union. The work was begun only the 1st of July, and no formal report of results has yet been prepare as the gathering of material and the examination of birds' stomac necessarily involve a great deal of preparatory labor. A bulletin

gration in the Mississippi Valley has, however, been prepared
. W. W. Cook, aided by Mr. Otto Widman and Prof. D. E. Lantz,
ll be published as Bulletin 10 of the Division.

principal ways of getting information desired must be (*a*) by per-
bservation of field agents; (*b*) by the co-operation of intelligent
ers on the farm, and in field, orchard, and forest, in all parts of the
y; (*c*) by the collection and analysis of stomach contents, and (*d*)
collation of what has already been published on the subject.
hese objects in view, circulars and schedules have been prepared
nt out to about one thousand of the regular observers of the
can Ornithologists' Union, to the editors of agricultural papers
riodicals throughout the country, and to a large number of far-
Replies are coming in very fast, and a special bulletin devoted
branch of the inquiry will soon be prepared.

collection of birds' stomachs has already resulted in the accumu-
of more than fifteen hundred bottles of gizzard contents, and it
ke a great deal of the time of the Division to have them properly
ied and determined. In order to secure exact data concerning
ird whose stomach is preserved, blank forms, asking for the num-
me of the bird, sex, date, hour of killing, locality, character of
where killed, name of collector, and remarks, were sent to all col-
tors. The very cursory examination made at the time of collect-
s material has developed facts before unsuspected, and results of
ance may confidently be anticipated from its final elaboration.

ther investigation added to the Divisional work during the year
en in relation to bee culture, which has hitherto received little or
ntion in the Department. The first work required of this Division
farmers of the country was the protection of their crops from in-
vages. Hence the chief energies of the Division, since under my
on, have been devoted to the improvement of insecticide appli-
and the discovery of improved insecticides, as well as to thorough
igation of the chief insects injurious to vegetation. As some of
have been completed or are drawing to a close, I am able to devote
ime to new fields. Apiculture, as an important branch of econ-
ntomology, deserves attention, and there are some questions which
partment can, perhaps, better consider than private individuals
ociations. Mr. Nelson W. McLain was, therefore, appointed as
apicultural agent of the Division. His headquarters have been
ora, Ill., a locality which is well suited for the work.

ong the subjects which I desire to have investigated in addition
e of more purely scientific interest, are the following:

To secure the introduction and domestication of such races of bees
reported to possess desirable traits and characteristics; to test
ims of such races of bees as to excellence, and to prove by ex-
nts their value to the apiculturists of the United States, and their
ation to our climate and honey-producing flora.

To make experiments in the crossing and mingling of races already
nced, and such as may hereafter be imported, and by proper ap-
on of the laws of breeding endeavor to secure the type or types
ted by habit and constitution to uses of practical bee-keepers
nited States.

make experiments in the methods of artificial fertilization, and,
le, demonstrate the best process by which the same may be
d.

y the true cause or causes of diseases yet imperfectly un-
the best methods of preventing or curing such diseases.

(5) To obtain incontestible results by intelligent experiments on scientific methods, as to the capacity of bees, under exceptional circumstances, to injure fruit; *i. e.*, to set at rest the ever-discussed question of bees *vs.* fruit.

A report from Mr. McLain is published with the other reports of agents, wherein interesting discussions will be found on various subjects, such as economy in the production of wax, on wintering bees, but particularly on artificial fertilization and on the question of bees *vs.* fruit.

The question as to whether bees really injure fruit or not at first hand is one that has been strenuously argued *pro* and *con*, and the position taken has been, without much doubt, more or less influenced by the interest of the writer, the fruit-grower as a rule taking the affirmative and the bee-keeper the negative position. The difficulty of getting unbiased results has been great, because of the difficulty in producing at will those exceptional conditions under which injury to fruit has been ordinarily reported, and I believe that never before have the same pains care been expended on an experiment as have been given by Mr. Mc in that he reports, the methods and precautions in which I have personally examined, endeavoring to provide for all possible contingenc The experiments show pretty conclusively that bees do not injure f at first hand, and this fact is in keeping with the structure of the dibles as compared with those of wasps (*Vespidæ*) which are gene charged with the real injury.

Mr. McLain also gives some figures to show the great importance o apiculture, and while there is need for more careful statistics of thi industry, I believe these can better be obtained through the ag o the statistical Division of the Department than through this spe agency.

So far as the limits allowed for this report have permitted, I l added, under the title of "Notes of the year," briefer references to few of the insects that have attracted attention, as evidenced by correspondence of the Division.

The labors of Mr. H. G. Hubbard, on the insects affecting the ora tree, have been concluded in Florida, and his report has been pre and the page proof all read, and since last September the whole wo has been waiting to be put to press. The fourth Report of the U. S Entomological Commission, viz., my final report on the Cotton-wo and Boll-worm, has also been completed since last summer, and slowly going through the press.

Dr. Packard has continued his special work on forest insects, l summer investigations having been made chiefly in Maine. A brie report from him on some of the insects studied is included.

Mr. Lawrence Bruner, in addition to the special work upon which has reported, has continued work, in conjunction with myself, on family of destructive locusts (*Acrididæ*), and otherwise to act as of the Division at West Point, Nebraska.

Prof. Herbert Osborn has been appointed to represent the Di at Ames, Iowa, and Miss M. E. Murtfeldt and Mr. J. G. Barlow made special investigations during the summer.

The exhibit of economic entomology prepared for the New Orle Exposition has been returned. The injury, unavoidable in the tr portation of such fragile objects, has been made good, and the collec deposited in the National Museum for permanent keeping, in accor ance with the policy hitherto adopted by the Division in reference t museum material. I may state in this connection that, with a view

; up a valuable national collection of insects, I have donated private collection to said National Museum, and shall bend my as entomologist of the Department, to increasing it, feeling thus co-operating with said museum the Department will al- ıve easy access to a reference collection, such as it would be im- or unsafe to accumulate in our own building, because of the accommodation, and the inflammable nature of the structure. ıclusion, I would again refer to the want of greater facilities for lication of the results of the work of the Division. The limited lowed in the Annual Report is insufficient to lay before the pub- esults of the work in detail, and we are seriously hampered for ıns of publishing any extended volumes requiring full illustra-

letin on the Periodical Cicada, one treating of certain parasites ious species, and another on the imported Elm Leaf-beetle, have blished during the year, and several others are ready for publi- or in preparation. One part of the work on insecticides, men- n my last report, has been finished and only needs revision. s the special printing fund of the Department be greatly in- , such works as the last-mentioned can be published only when by Congress. Yet when, a year ago, your predecessor asked to o monographs from this Division ordered by Congress, the Sen- mittee on printing declined to order the same, on the ground that ot wish to establish a precedent for the publication of such mono- by this Department. One of these, viz., that by Dr. S. W. Willis- the *Syrphidæ* (a family of two-winged flies of considerable import- the farmer because of their being essentially predaceous) will, e, necessarily be published elsewhere. I can see no reason why partment should not extend its usefulness and promote scientific ure by the publication of more elaborate memoirs, as the other c Departments of the Government do. So far as the Entomo- Division is concerned, I have for some time, as expressed in s reports, felt the desirability of issuing, from time to time, hs that shall do credit to the Division, and would urge that taken to establish this precedent. In addition to the special s it would also be very desirable, as recommended in my report –'82, to issue a periodical or serial bulletin that would set before lic, at stated intervals, while it is fresh, the gist of the more im- investigations and facts of interest, as elicited in the corre- ıce and work of the Division.

ce force remains essentially the same as a year ago. Dr. Bar- been relieved, and Mr. Otto Lugger, of Baltimore, appointed. ın has continued work on the bibliography of economic entomol- l Mr. Koebele is temporarily stationed at Alameda, Cal. I take e, in conclusion, in acknowledging the efficient services of Mr. Walker, in the sericultural work, and the aid of my first assist- . Howard, and of Mr. Schwarz and Mr. Pergande, both in the work and in preparing this report. The drawings, as hitherto, en prepared, where not otherwise stated, either by Mr. Marx or livan, with my correction and supervision.

ully submitted, December 24, 1885.

C. V. RILEY,
Entomologist.

AN J. COLMAN,
Commissioner.

SILK CULTURE.

Since our last annual report was submitted the work of the Division in encouraging and developing silk culture has been continued with the additional clerical force which the appropriation in favor of the industry made it possible to employ. Three hundred ounces of silk-w eggs were purchased in France and received in Washington in D of 1884. During the first three months of the present year, these egg were distributed among eight hundred and fifty applicants, inhab almost every State in the Union. By far the largest number of a cations came from Illinois, while Kansas, Louisiana, and Ohio test strongly to the interest felt in the industry. Eggs were distributed packages of one-twentieth of an ounce, one-tenth of an ounce, and l quantities, the apportionment being made with due consideration experience of the applicant and the silk-worm food accessible. Thro ignorance of the art of raising silk-worms, many have asked for larger quantities of eggs than they could possibly raise in their ex perience. For these we have been obliged to judge in what may seemed an arbitrary manner, and they have always received but s quantity. This, while not enough to insure profit, has been quite cient to enable the raisers to acquire some of that experience wit which no industry can be successfully carried on.

DISTRIBUTION OF MULBERRY TREES.

The Division has co-operated with the superintendent of garde grounds in the distribution of some eight thousand mulberry trees to sons interested in silk culture. We are not in favor of an indiscrimin distribution of food-plants, for various reasons. Chief among th the fact that neither the Osage Orange nor the Mulberry can be den of their leaves without injury until the plant has reached at least fourth year. This lapse of time is discouraging to silk-raisers, and w waiting for their trees to acquire the requisite size they lose their terest in the industry or become discouraged. It has been urged l nurserymen that one of the duties of the Department in fosteri culture was to encourage the setting out of large mulberry plant so that, as the interest in the work grows, silk-raisers may find abundance of food of easy access. But the great flurry of 1838 rather caused by nurserymen than by silk culturists, and the furor planting the multicaulis, rivaling as it did the tulip craze of Holla led to the ruin of many rich men. Although such an event could be looked for again, experience teaches that we must take grea not to allow ourselves to be led into a false policy by interested parti The mulberry planting of that period, as well as at prior and subs quent times, has left large numbers of trees scattered over the countr which will enable silk-raisers to make the experiments necessary assure themselves if their interest in the industry is to be lasting whether it is to die out after the first season.

We have often called attention to the use of the Osage Orange as food-plant, and in the section where it is so largely used for hedging is now the common material used in feeding silk-worms. This secti has its center in the State of Illinois, where the supply appears to practically unlimited, and it stretches on the east to Central Ohio a in the west into the eastern counties of Nebraska and Kansas, w it is becoming more plentiful as the country becomes more thickly

led. Throughout these latter States the Mennonites have planted arge numbers of the Russian mulberry (*Morus tartarica*), which makes an excellent wind-break and is so hardy as to stand the winters of Dakota. The wood is excellent, being largely used for fence posts, and the foliage makes, so far as our present experience goes, a good silk-worm food. In view of all these facts the distribution of mulberry plants has not been pushed, and we have thought it wiser to allow people to set out their own plantations and reserve our means for helping them in other directions.

DISTRIBUTION OF EGGS.

The eggs distributed last year were purchased in France from reliable dealers. They were all of a yellow annual race, usually called French. In regard to this designation of races a few words of explanation are required. Prior to the silk-worm plague of twenty years ago in Europe, there was a certain degree of exactness in the lines drawn between the races raised in different provinces. Then, however, the indigenous races were to a large extent blotted out, and egg merchants went first to Turkey, then to Asia Minor and Syria, and finally to China and Japan in search of eggs that should be free from "the malady." Thus it was that there were brought into France and Italy a large number of races foreign to those countries. These were crossed together and, after the researches of Pasteur had made the resuscitation of the native races possible, they were crossed with these as well. Thus the identity of the old varieties became lost and the same new stock appeared in different sections under different names. Samples of French and Italian yellow cocoons sent us last summer appear to be identical, and to be again very like some called "Turkish salmon."

HOME-RAISED VS. IMPORTED EGGS.

A good deal of feeling was exhibited by American silk-raisers on account of this purchase of eggs abroad, as they considered the production of eggs a part of the industry which should be fostered in the United States. With this feeling we do not entirely sympathize. In the first place, the Department can distribute but a comparatively small quantity of silk-worm eggs each year, and they can be produced by a very small number of persons. The production of these eggs requires great care and extended experience in this branch of the art. There are many precautions with which it is necessary to surround the work, and we consider them of such moment that we have set them forth at length in another portion of this report. The experience thus required is somewhat hard to find among the silk-raisers of this country. Those who have already produced eggs for sale have relied more upon the freedom of this continent from the germs of disease than upon scientific methods for its prevention, and while sericultural Europe was plague-stricken, several American silk-raisers seized the opportunity to pro- e eggs for the European market and succeeded in realizing consid- le profits. But the day for such work is past. Europe to-day can duce eggs of sufficient purity for her purposes and "the malady" has crept into the United States with imported eggs. Silk-raisers tempted to reproduce from this stock, but knowing nothing of the y precautions of which we have already spoken, have produced poor class of eggs, which in many cases have been highly dis- h the *pébrine*. While patriotic motives would induce us to

give the preference to home-raised eggs, yet we felt the necessity of using great care in purchasing eggs from American raisers, and for these reasons we have only accepted those that are sent us in sacks, containing the laying of one moth per sack, with the mother inclosed. These moths have been submitted to the careful microscopical examination required, and we have thus been able to guard against the purchase of any diseased eggs. The sequence has shown the precaution to have been necessary, for several large lots, accompanied by fine-looking cocoons and a report from the raiser to the effect that the worms were robust and to all appearances healthy, have at once shown disease when submitted to the crucial test of the microscope.

About 600 ounces of eggs have been provided for the distribution which is to take place during the coming winter and spring. In applying for these eggs silk-raisers state whether or no they wish to winter their own eggs. If they themselves prefer to care for them, the eggs will be sent out before the end of January, otherwise they will be kept in Washington until the foliage in the different sections of the country is ready to feed the worms. We have been led to make this change in the method of distribution from the fact that a good many lots of eggs were lost last year through premature hatching, because the silk-raisers to whom they were sent were unprovided with suitable means for keeping them through the warm days of early spring.

The eggs have been received from thirty-nine persons residing in different parts of the country. They have been submitted to the scrupulous microscopical examination described later in this report, so that it might be possible to select those untainted with the *pébrine*. This has proved to be a greater labor than was anticipated, and has occupied attention of the office all through the fall. Besides the accepted eggs thirteen lots, amounting in all to 130 ounces, have been rejected because they were pébrinous. Sometimes the malady has been so marked as to appear upon a very superficial examination of the moths, while again it has been necessary to push the test much deeper in order to make sure of the existence of the disease.

It is very questionable whether silk culture will be permanently promoted by this encouragement to promiscuous egg production.

Those who advertise silk culture as an industry suitable to old persons, invalids, and children, by virtue of its being light, easy work, do the cause harm. Silk culture may be light as compared with the more severe labor that our farmers' wives are often obliged to do, but it is none the less true that to many persons who have tried silk raising the labor involved has seemed arduous. There is, to be sure, no heavy physical labor, but the raising of silk-worms involves attentive and constant care, especially during the last stage. The aged, the feeble, and the young may assist, but activity and intelligence must guide.

THE ESTABLISHING OF FILATURES—COST OF PRODUCING REELED SILK.

We have repeatedly pointed out in previous reports the importance to the success of silk culture of the establishment of filatures where the cocoons produced in the United States may be reeled and thus find a market. Until Congress made a special appropriation for the encouragement of the industry, it was impossible for this Department to undertake the establishment of such institutions. During the past year, however, we have been able to accomplish this object, to a limited extent at least, and with this end in view two stations were established

t spring. One of these was at Philadelphia in charge of the president of the Silk Association there, Mrs. John Lucas, and the other at New Orleans under the direction of Mr. Jules Herbelin.

The following figures and estimates have been prepared by Mr. Walker, those of the Philadelphia station from his personal examination of the books, and those of the New Orleans station from the reports and correspondence of Mr. Herbelin:

"Work at the Philadelphia station did not commence in earnest until the beginning of the present fiscal year. Since that time, during the months of July, August, and September, 518 pounds 11 ounces of cocoons were consumed in the production of 96 pounds 1⅞ ounces of raw silk. This requires 5.39 pounds of cocoons for 1 pound of reeled silk. The quality of the stock handled is thus shown to be very bad, 4 pounds being considered excessive. Some of the trouble is undoubtedly to be attributed to inexperienced labor, but the principal difficulty was without doubt in the inferior grade of cocoons used. These cocoons cost, on the average, 85 cents per pound, so that the raw material used in the production of a pound of silk cost $4.58. What has been sold of this silk has brought $4.40 per pound, from which it will be seen that the cost of the raw material was greater than the value of the manufactured product. Under the circumstances this is not much to be wondered at, when we take into account the fact that the greater part of the cocoons were produced by raisers who were absolutely without experience. These raisers, though they produce an inferior product, expect a good price for it, and in encouragement of the new industry it has been thought better to give it. Under commercial circumstances, at the present value of silk, the cocoons used in this work should not cost more than 60 cents per pound. The labor entering into the production of this silk consisted of 1,942 hours of a reeler, at a cost of $232.50, and the expense of cocoon sorting, amounting to $56.25, or a total cost of $288.75 for productive labor. This is about $3 per pound of reeled silk, or a total cost of $7.58 per pound. The general expenses accompanying such experiments are always heavy, and should not be counted to the detriment of the work. Under commercial circumstances they are generally covered by the sale of silk waste, the receipts for which are not herein credited to the Philadelphia account.*

"The New Orleans filature was opened on the 15th of April, and was run continuously in that city until the 31st of August. During that time there were purchased 4,267 pounds of cocoons in a more or less dry condition. They are estimated to be equivalent to 3,360 pounds of dry cocoons and cost an average of $1 per dry pound. Of these cocoons, 2,710.15 pounds were reeled during the period mentioned, and from them were produced 641 pounds of reeled silk. This gives us 4.228 pounds of dry cocoons per pound of reeled silk. This is not what we may call a good result, but we cannot hope for a better with the quality of cocoons that Mr. Herbelin has to deal with. Four hundred of the 641 pounds of reeled silk mentioned above have been sold at $4.50 per pound, making the value of the reeled lot $2,884.50, if the balance be sold at the same price. The cocoons entering into this silk cost, as has been said, $2,710.15, or about 94 per cent. of the value of the manufactured material, or, again, about $4.23 per pound reeled silk. The labor employed in mak-

* A later report (December 29) from Mrs. Lucas makes the rendition much more favorable, showing, in fact, that from 722 pounds of cocoons, 200 pounds of commercial silk was produced. This would be an improvement so unexampled since the writer's report that there is evidently some error.

ing this silk cost $1,073, or about $1.67 per pound, making cost of the silk about $5.90 per pound.

"This cost was, to go more into detail, divided up in the follow manner:

4.23 pounds dry cocoons, at $1 per pound	$4
Labor:	
Cooking, brushing, and reeling	
Cocoon sorting	
Forewoman	
Engineer	
Total	5

"In discussing these figures it may at once be said that the forewo and engineer could as well have handled forty basins as the six wl they had in charge in their respective capacities. We may thei with justice place the value of their work in the New Orleans fila at six-fortieths of the amount stated above. This reduction will bring the corrected cost per pound to:

Cocoons	$
Labor:	
Cooking, brushing, and reeling	
Cocoon sorting	
Forewoman ($\frac{6}{40}$ of $0.276)	
Engineer ($\frac{6}{40}$ of $0.368)	
Total	

"The difference in the cost of production between the silk ree New Orleans and that reeled in Philadelphia is somewhat due to superior price paid for labor at the Northern station, where the re earn 10 cents per hour, while in New Orleans they can be employ 7½ cents."*

In our last annual report (p. 286) the opinion was expressed that future of silk culture in America would depend largely on the suc the Serrell automatic silk reel. The flatness of the French money ket and the slowness of issuing of Mr. Serrell's patents have preve thus far the setting up of any of these reels in the United States. of his American patents have now been granted, but, as they are in relation to details, we are still unable to give an account of his provements; but the experiments carried on in France have that the following economies may be effected by the use of this mac ery, as compared with the ordinary French systems, to which cl Philadelphia and New Orleans reels belong. It has been found on account of the more equitable handling of the cocoons by aut machinery, a pound of silk can be produced from 10 per cent. less material than when ordinary hand machinery is used. Again, it has shown that with the Serrell reel 50 per cent. of the number of empl can produce one-third more silk per day than is commonly prod with hand machinery. The cause of this economy is as follows: I

* During the six weeks intervening between the preparation of the above esti and the proof-reading (January 16, 1886), a decided movement has taken place i market for reeled silk, prices for silks having risen from 15 to 20 per cent. It v first thought that this advance had a speculative basis, but later advices seem to ate still better prices, with a firm and active market. Anticipating this furth ance, American importers and manufacturers have laid in a large stock of ilk, the value of imports in December, 1885, having reached $2,916,496, as $1,120,199 in December, 1884. This increase in value of imports during the past brings the total for 1885 to $15,157,465, as against $13,777,908 in 1884.

:st place, a given number of operatives can run twice as many Serrell :els as ordinary French reels. In the second, in the ordinary operation f the latter a woman uses one-quarter of her time in preparing her ocoons to be reeled, and during that time her reel stands idle; but by he Serrell system the cocoons are prepared by particular operatives, who do nothing else, and the reels are run constantly. We here gain, then, 50 per cent. by the saving in the number of operatives, and 25 per cent. of the remaining 50 per cent., or 12½ per cent., through increased production, and have, in all, 62½ per cent. of economy of labor.

Applying these economies to the corrected cost of production at New Orleans, as given above, it would be reduced to:

Cocoons ($4.23 less 10 per cent. or $0.42)	$3.810
Labor:	
Reelers, &c. ($0.939 less 62½ per cent. or $0.587)	.352
Sorters ($0.089), forewoman ($0.042), engineer ($0.055)	.186
Total cost of producing 1 pound of reeled silk with Serrell reels under the above circumstances	4.348

A recent letter from Mr. Serrell informs us of the shipment of one of his reels to the Department for use in making experiments, and it will then be possible to verify the figures given above.

WORK ON THE PACIFIC COAST.

In addition to the two agents mentioned above, it was deemed advisable that the Division should be represented on the Pacific coast, and Mr. Charles Wolcott Brooks was therefore appointed as superintendent of experiments in silk culture at San Francisco. This position he held until his death, in August, when he was succeeded by Mr. William M. Noyes, our present representative. Under Mr. Brooks's superintendence and the immediate direction of Mr. B. H. Carter, of Oakland, an experimental crop of silk-worms was raised last spring at the Tompkins school-building in that city. The worms, however, were unfortunately received by Mr. Carter after they had hatched, and their being improperly cared for during their first days had a bad effect upon their subsequent health and growth. Some of the choice cocoons were, however, used for the production of eggs, which will be distributed throughout the State during the coming winter.

In previous reports we have mentioned the formation of the California Silk Culture Association and of the State board of silk culture of California. The association continued in its original form until the beginning of the present year, when its members were incorporated as the "Ladies' Silk Culture Society of California." The old association was always active in promoting silk culture throughout the State, and the society has followed in its footsteps, distributing literature, silk-worm eggs, and food-plants to silk-raisers. Soon after its incorporation the society was presented with a piece of land containing about 15 acres, situated in Piedmont, in Alameda County. On this land it was their intention to establish a model sericultural station. In this object they have been assisted by the Department of Agriculture, a building of suitable size and arrangement to serve as a cocoonery having been erected at Piedmont in the month of June last. Here it is intended to set out plantations of food-plants and to raise a small crop of silk-worms each year, with three distinct objects in view. The first, and perhaps the most important, is the investigation of all matters of scien-

tific interest in connection with silk culture, such as the best methods of raising silk-worms and their food, the adaptability of different food-plants to the climate of California, &c. A review will be made of the researches of M. Pasteur into the diseases of silk-worms in the light of investigations into the lower orders of vegetable life that have been made since his "Studies" were published. These and a great many other questions will naturally occupy the attention of the expert director of the Piedmont station. Secondly, during the silk-raising season, pupils will be taught how to raise silk-worms after the most approved and economic methods; and thirdly, the crop resulting from the annual experiments, will, if suitable, be used in the production of silk-worm eggs, to be distributed gratuitously to the silk-raisers of the Pacific coast. A director for this station has been appointed in the person of Mr. A. Werner, who comes to us with several years' experience of a similar kind in Austria.

The State board of silk culture, though created for four years, had funds appropriated for its use for two years only. These funds were exhausted some months before the biennial period had elapsed, and the active work of the board came to a premature end. This board was succeeded by a new one created in accordance with an act approved March 18, 1885, which appropriated $5,000 per year, for two years, for the encouragement of silk culture. In pursuance of this law the present board is now acting under the presidency of Mrs. Olive M. Washburn. The first board established an experimental and educational filature in the city of San Francisco. At this filature there were received, from the crop of 1883, 509 pounds of cocoons, and from that of 1884, 753 pounds. Although it was estimated that the State produced 1,500 pounds of cocoons during the former season, the estimate appears to be excessive, competent judges giving it as their opinion that two-thirds, at least, of the crop was purchased at the State filature. On June 22, 1885, the new board reopened this establishment, which had been temporarily closed for lack of funds to carry it on, and the report of the filature committee of the board, just published, informs us that 44 pounds of silk had been reeled there during the present summer. The school has consisted of 19 pupils, who have attended at different times and been taught to reel silk by an expert Italian operative. The California cocoon crop of the past season is estimated at but 250 pounds. No reason is ascribed for this falling off in the production. The State board has distributed a large quantity of sericultural literature, and the old organization was instrumental in the delivery of several lectures and addresses upon silk culture in different parts of the State. The board has recently placed $400 at the disposition of the Ladies' Society for the improvement of its land at Piedmont.

An effort was made last winter by Mr. Joseph Neumann and some of his associates to launch the "California Silk Culture Development Company," with a capital of $100,000. The attempt was a failure, as, in our opinion, all attempts to exploit silk culture on a large scale will be. A curious error was made in their prospectus, curious because it is often made and often goes undetected. This is the calculation of the production, per ounce, of eggs, such as would be proper for fresh cocoons, and the estimation of their value as that of dry cocoons. The misconception that will arise from such figures will be understood when it is remembered that cocoons lose, in drying, two-thirds of their original weight, and that, therefore, for the same quality of cocoons, they are worth three times as much per pound when dry as when first made.

E PRECAUTIONS NECESSARY IN THE PRODUCTION OF PURE ILK-WORM EGGS, AND IN PROPERLY WINTERING THEM.

such accurate knowledge as we have of the diseases affecting the ry silk-worm we are largely indebted to the French savant, Louis r, who made them the subject of exhaustive researches. He when he turned his attention to the matter, a long list of maladies marks of distinction were anything but clearly drawn. After a study of these, however, he writes: "I ought to say that I know ır well-marked diseases among silk-worms. They are the *gras*-he *muscardine*, the *flacherie*, and the *pébrine*. All others appear o be merged in these."* The first two can be easily disposed of, *grasserie* never appears in the moth and cannot, therefore, affect gs. The *muscardine*, though it may be so slightly developed that rm is permitted to spin, will invariably destroy the chrysalis, he disease can never originate at this state, as the insect is pro-by its cocoon. The moth, if kept free from larvæ affected with ease, is never afflicted with the *muscardine*. Her eggs, therefore, contain its spores. But, in the *flacherie* and the *pébrine*, we have eases so contagious and so destructive that it is necessary to them by stringent and thorough measures.

FLACCIDITY (FLACHERIE).

ntoms and Consequences.—Before treating of preventives or reme-owever, it will be well to describe the symptoms of the two dis-nd the means of detecting them, so that the measures which it ssary to take in order to obtain eggs free from their influence, better understood. When, after the worms have passed their molt, and are eating well and regularly, they have all the appear-perfect health and vigor and the silk-raiser feels full confidence success of his crop, some will often be seen to crawl to the edges trays, and lie there languid and without motion. But for the their wonted activity and the cessation of their naturally vora-ppetite, one would still think the worms in full possession of per-alth, for they still retain all the outward perfection of form that re remarked above. In color they have perhaps become some-nore rosy, especially if the disease is in a violent form. On touch-em, however, we find them soft, and even in this seemingly ndition they are often dead. Had the worms been carefully ob-at this time, it would have been seen that the beating of the vessel was gradually becoming slower, and that it finally stopped ther; and that the worm was excreting a dirty liquid which soiled al orifice and gradually closed it. Before many hours are passed in begins to shrivel and draw in around the fourth and fifth joints body, viz, those two lying between the set bearing the legs proper e set bearing the prolegs. Later, at this restricted point, the egins to turn brown, then black, and the whole worm is soon in anced state of putrefaction. Then, and even before the death of rm, a sour odor is perceptible in the *magnanerie*, due to the fatty acids exuded by the victims to the disease. Should the malady the insects at a later period, when they are ready to spin their the same languishing air will be observed; they will show a e to crawl up into the arches, and will be seen to gather around

*"*Études Sur la Maladie des Vers à Soie,*" vol. i, p. 225.

their base seeking some place to spin their cocoons which it requires no exertion to attain. Many of those which reach the branches stretch themselves out motionless on the twigs and die there They are to be seen later hanging by their prolegs in different states of putrefaction (Plate II, Fig. 1). When these symptoms are observed we may be sure that the worms are attacked by flaccidity (*flacherie*).

Nature and Treatment.—A full discussion of the causes of and treatment for this disease will be given in Bulletin No. 9, of this Division. Our present object is only to describe the indications of the malady with such fullness that it may be readily known to the silk-raiser. Where the symptoms given above are not sufficiently obvious, and where it is necessary to make assurance doubly sure, a microscopic examination of the intestines of the sick worm should be resorted to. Here will be found masses of undigested food, and the coats of the intestines will be found to be opaque. Here, too, the microscope reveals the parasites ordinarily attending putrefaction, chief among which is a bacillus, seen sometimes with and sometimes without a bright nucleus. There also exists a special form of ferment, not unlike that which accompanies the formation of vinegar (*Mycoderma aceti* Pasteur), which is found in short chains, the links of which are almost spherical in form (Plate III, Fig. 1). These two parasites are sometimes found together and sometimes separately. When the bacillus is abundant death quickly follows its appearance, and the disease, spreading rapidly, will sometimes destroy a whole school in a single day. At times this bacillus appears so short a time before the spinning of the cocoon that the worms are able to mount into the branches, and even make their cocoons and become chrysalides. Then, however, the disease overcomes them and their putrefa produces foul cocoons. This case is, however, more rare, and in genera the bacillus is not often found in the chrysalis. When the ferm alone appears, the disease progresses differently. The worms then show the same languor on the approach of the spinning period, and the same indisposition to make their cocoons; but even then they mount the branches, perform their work of spinning, are transformed into chrysalides, and these into moths which may have a fine appearance. The silk crop may even be exceptionably good; but where this state has existed, when the worm has been without its usual agility at the spinning time, where it has shown this apparent laziness, then, though cocoons be of the firmest and the moths the finest, still there will e weakness, a constitutional debility that will show itself in the next generation. This is the only way in which flaccidity is hereditary, in t predisposition of the worm to succumb to disease on account of the affection which weakened but which did not kill the parent.

When these apparent troubles are seen, we need look no farther fo signs of the malady, but at once reject the stock as unfit for reproduction But, as it is not always possible for the egg-producer to have thu watched the rearing of the worms, it will be well to describe a mean by which flaccidity may be detected in the chrysalis, so that if the stoc be unfit for egg production the cocoons may be stifled and their valu not injured by the emergence of the moth. For this purpose we can d no better than give a translation of the instructions published by Pasteur on this point, with their accompanying illustrations.* They a as follows:

"Cut away the wall of the thorax of the chrysalis with fine scisso as shown in Plate II, Fig. 2, so as to reveal the stomach *s*. Draw th

* *Études Sur la Maladie des Vers à Soie*, vol. i, p. 233.

ı a pair of tweezers. The restricted part of the digestive tube, nites the stomach with the urinal sack, *u*, should then be cut. erior part of the digestive tube now alone holds the stomach in ıd this easily gives way. Lay the small ball thus withdrawn on ılide and scratch away the very soft fatty envelope which covers rior. Of this interior substance take a piece as big as the head , wash it with a drop of distilled water, and, placing it upon a th a cover-glass over it, examine it with a microscope magnify- ıt four hundred diameters. With a little experience this work done very rapidly. It would be well to take out at the same stomachs of, say, twenty chrysalides, and lay them on as many des. * * *

first few days after the formation of the chrysalis the contents tomach are generally very liquid, which makes their extraction nient. It is better to make these observations seven or eight er the spinning begins, when the matter will be found to have nsistence. * * * Plate III, Fig. 1, shows the appearance erment found in flaccid chrysalides under a magnifying power hundred diameters. It is associated with the débris of leaves, of the trachea, and chlorophyl cells. These matters ordinarily ıny the little ferment in the stomach of the chrysalis because of mplete digestion of the leaf whenever it is submitted to fermen-

PÉBRINE.

oms.—"The disease, *pébrine*, shows itself outwardly by the ıg away of the worms and their inequality of size; eating little, not grow as large as when in their normal state. At the end days black spots frequently make their appearance on the skin, ing punctures or burns."* Plate II, Fig. 4, "represents, twice ıral size, the anterior part of the body of sick worms covered with s of which I treat. In one of the worms, *a*, they are just becom- ble, and the eye should be aided by a magnifying glass to render stinct; the other, *b*, shows them farther advanced, easily recog- with the naked eye, if the worm be examined with a little at-

Finally, Fig. 3 shows one ring spotted with the *pébrine*, mag- six diameters. For this cut was chosen a worm bearing two marks, one with clear cut edges, the others surrounded with a The first are wounds, the others the true spots belonging to the and serving as an indication of its existence, if not always, at der many circumstances. The halos in question have generally ish tint; they must be observed through a magnifying glass to seen."† "The anal horn, the prolegs, the soft parts between the e especially subject to these black spots. In the interior of the icroscopic observation reveals the presence of innumerable cor- of an ovoid shape (Plate III, Fig. 2), filling the cells of the walls tomach, those of the silk glands, the muscles, the fatty tissue, ı, the nerves, in a word, all the portions of the body. There are many of them that the cells of the silk glands become swollen ite and appear to the naked eye to be sprinkled over with chalky the silky liquid always remains exempt from this parasite, but h less abundant than when the worm is in a healthy state."‡

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* Maillot, *Leçons sur le Vers à soie du Murier, &c.*, p. 96.
† Pasteur, *Études, &c.*, p. 15.
‡ Maillot, *Leçons, &c.*, pp. 96, 97.

In addition to these exterior symptoms it is noticed that the prolegs do not seem to attach themselves easily to objects. In the chrysalisthe abdomen is very much swollen and the rings stretched, while in the moth, part of the body and the wings have a leaden color. This must not be confounded with a certain natural brownness which some healthy moths exhibit and which extends over the whole body.

Tests for the Determination of Pébrine.—The corpuscles mentioned in the above quotation are found in all the stages of the insect's life from the egg to the moth, whence they again pass from the mother into the egg. The disease is, therefore, strictly speaking, more hereditary than is flaccidity, which passes from one generation to another only in an indirect manner, as already described. It has been found that corpuscles in the male cannot affect the eggs, and that the disease passes from the female only. Pasteur took advantage of these points in his system of microscopic selection. By making an examination of the female moth he was enabled to predict that if she were pébrinous her issue would also be affected with the malady, while if she were healthy the eggs also would be free from its germ. He found, if the *pébrine* were contracted after the fourth molt, that, under ordinary circumstances, the larva would show no external signs of it, while the moth, and therefore her issue, would be found to be swarming with corpuscles. It is wise, if the stock is to be used for reproduction, to microscopically examine some of the worms which spin last, in search of the parasite. If any of the school are diseased, these laggards will most certainly be. Unless the insects, therefore, be submitted to examination at this time or while in the chrysalis state, the silk-raiser may have no means of ascertaining whether or not the *pébrine* exists until the contents of the moth are placed under the microscope, when it will be too late to stifle the cocoons. There is none of the languor in pébrinous worms which is found in the flaccid larvæ just before spinning. The sericulturist therefore, who wishes to obtain good stock, will, if wise, make the examination of the larva and afterwards follow up the process through the different operations to be hereinafter described.

Isolation and Examination of the Moths.—If left to themselves the insects remain in the chrysalis state for from two to three weeks in our ordinary summer weather. This development may, however, be hastened or retarded by increasing or lowering the temperature. This fact is taken advantage of to obtain a few adult insects, which may be microscopically examined before the whole lot becomes fully developed.

We were very much pleased with Maillot's method, which he explained and exhibited to us at Montpellier, in 1884, and here give a description of it in his own words: "Three or four days before the cocoons are taken from the branches, we take, here and there, from the early spinners as well as from the late, several hundred cocoons; as, for example, five hundred from a lot of 90 pounds. This sample should be placed in an oven or warm room, where it will be kept day and night at a temperature of from 100° to 110° F., and a high degree of humidity. In this way the formation of the moths is hastened. As during this time the cocoons of the lot itself are remaining at a temperature of from 75° to 90°, and often during the night at even lower temperatures, we shall still have time to stifle them if the lot is discarded, or to string them into chains if on the contrary it proves healthy.

"Every two days we take ten chrysalides from the sample and examine them microscopically for corpuscles. If we find them in the eight or ten days, no matter in how small quantities, we can be sure that the proportion of pébrinous moths will be considerable. We

chrysalides are mature, which is easily seen by their eyes becoming k and the eggs harder to break under the pestle, and also that some iem are turning into moths, we proceed to the definite examination. crush, one by one, the moths which have come out and the chrysa- s which remain, and search for corpuscles; the per cent. which is found will not differ materially from that which exists in the le lot."*

ie examination of the chrysalides here mentioned may be made in manner already described when searching for the ferment of flac- y and at the same time.

oceeding now with stock of which the purity has been ascertained ne or more of the different methods of observation above described, cocoons should be selected for each ounce of eggs that it is desired roduce. In making this selection great care should be exercised in ng only cocoons that are fine in texture and firmly made. This ness is one of the prerequisites of a first-class cocoon. What is nt by this difference in texture will be seen by an examination of e IV, Figs. 3 and 4, the former being fine and the latter coarse. firmness of the cocoon, depending as it does on the amount of silk h it contains, is an indication of the vigor of the worm and another to be considered in selecting stock for reproduction. Rules have given for the determination of the sex of the inclosed insect, and ng them, perhaps the most common, is the assertion that those are constricted at the middle (Plate IV, Fig. 3) contain males, while e not constricted (Fig. 4) contain females. This, however, may be rded as an indication rather than a fixed rule, and there are races hich the cocoon is almost uniformly constricted and others where reverse is true. But this careful selection for sex is comparatively portant, and we consider it wiser to choose the cocoons in relation ir firmness and texture and trust to chance to bring as many male s as female. Double cocoons, where two worms have spun to- er, should never be used in egg-making.

ie proper cocoons having thus been selected they should be strung stout threads about 3 feet long. Care should be taken not to the chrysalides with the needle while passing it through the end cocoon in making the chains. These chains should then be hung cool, darkened room, while waiting for the moths to emerge. They l not be placed near any object which would be soiled by the cions emitted by the moths on their emergence from their cocoons. evious to this emergence there should be prepared for each ounce gs to be produced, about one hundred small bags of fine muslin ese cloth makes a good material), made in the following manner: the cloth in pieces 3 by 6 inches, then fold one end over so as to e a single edge of about three-quarters of an inch, as shown in Plate Fig. 1. This should be sewn up into a bag with the upper end open then turned inside out so that the seams will cause the sides to e. Thus completed they are called "cells." The cells should be on a cord stretched across the room. Some trouble having been enced in keeping the moth from crawling out of the cell at either of the pin, which is the method of closing it shown in the figure, me shown in Plate IV, Fig. 2, was adopted in this office. This s in clamping the bags in fours between two sticks of wood, rough about one-half by one-quarter inch through, and 14 inches long. ound together by rubber bands and may be laid across par-

* Maillot, *Leçons, &c.*, p. 250.

allel wires stretched across the room at about 13 inches apart. M. Pasteur suggests that a simple piece of cloth about 4 inches square be used instead of the sack. The moth lays her eggs on this and is then retained by being fastened to the cloth, the corner of which is turned up over her and a pin passed through it and over her wings. Some trouble has been experienced by this process, as the eggs, if not properly gummed to the cloth, will sometimes fall off and be lost, and the moths, not being confined as in the sacks, will wander to other cloths and get their eggs mixed with those of other moths, which would be detrimental to the microscopical selection to be hereafter described. It has the advantage, however, of enabling the microscopist to avoid the labor of turning the sacks.

The moths emerge from the cocoons, as a rule, from 5 to 8 o'clock in the morning. At the latter hour many of them will be found coupled and clinging to the chains. These should be carefully taken by the wings and placed upon a table by themselves, the single moths being placed upon another table where they will couple if the sexes are evenly divided. They should then be transferred to the other table as the fluttering of the male moths is apt to disturb the couples. These should be left together until 4 or 5 o'clock in the afternoon, when they may be separated by drawing them gently apart by the wings. The females should then be placed in the cells or upon the cloths already described, where they will at once commence their egg laying, completing it in about thirty-six hours. Most of the males may then be thrown away, though it may be wise to keep a few of the more active ones to compensate for any superbundance of females in the issue of the following day. But little difficulty will be encountered in distinguishing the sexes, the males being noticeable by their smaller abdomens, more robust antennæ and by their greater activity.

When the eggs have been laid, the microscopical examination of the moths should be made with a view to ascertaining whether or no they are afflicted with *pébrine*. The entire moth should be ground up with a few drops of distilled water in a small glass mortar (2-ounce is a convenient size). A drop of this water is then taken with a medicine dropper and placed upon a glass slide with a cover-glass over it. It is then microscopically examined with a power greater than three hundred diameters. Plate III, Fig, 2, shows a field very highly charged with the corpuscles of the *pébrine*. When the moths are allowed to lie before examination for some time after their death, they will be found to contain other germs peculiar to putrefaction. These do not indicate any disease that would affect the egg or its issue; nor does their presence imply any lack of vigor in the parents. They are simply *post mortem* parasites. Great care should be taken in cleansing the mortar, pestle and other implements before making an examination, by washing them in an abundance of water and rinsing them thoroughly with distilled water. In making the above examination only the corpuscle of *pébrine* need be looked for. The bacilli and ferments of flaccidity are rarely found in the moth.

The corpuscle of the *pébrine* is generally oval, though sometimes pear-shaped in form, being from 3 to 4 μ* on its greatest axis and about one-half that length on the shorter. It is generally found singly The ferment of flaccidity is usually found in short chains, whose links, almost spherical, have a diameter of about 1 μ. The two organisms were very generally confounded twenty-five years ago, and much confusion still prevails among writers in reference to them.

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* μ = 0.001^{mm} = 0.00004 inch.

WINTERING THE EGGS.

g of the silk-worm moth is of a bright yellow color when laid. operly fecundated, it turns gradually, in five or six days, to an bluish gray, or sometimes to an earthy yellow. If sterile it s original hue. It is oval and slightly flattened in shape, being on one side. Near one end a small spot may be observed. led the *micropyle*, and is the opening through which the fecun- quid is injected just before the egg is deposited by the female. cundation and before deposition the egg is covered with a arnish which closes the micropyle and serves also to stick to t upon which it is laid. It is at the micropyle also that the rva always eats its way through the shell. The mean diameter gg is about 1 millimeter (one twenty-fifth of an inch) though it ith the race. In a standard ounce of 25 grams (28⅓ grams voirdupois) there are about 50,000 eggs of the small Japanese ,500 of the ordinary yellow annual varieties, and from 30,000 in the races with large cocoons. The specific gravity of the lightly greater than water, Haberlandt having placed it at 1.08. gs may be removed from the cloths on which they are laid by hem some time in water, which softens the varnish surrounding d then scraping them off with a paper-cutter or an ordinary fe.

changing color the contents of the egg undergo a chemical bsorbing oxygen and giving off carbonic acid. This absorption n is very active during the first six days, after which it rapidly and continues at a very low figure during the months which the hatching. The eggs should, therefore, be wintered in such r that they may have plenty of air; otherwise their development eriously interfered with. They must not be packed in too thick nt should be spread out thinly. For these reasons the eggs at artment are kept through the winter in boxes of perforated tin, oms of which have a surface of 6½ square inches, each box con- ot more than one-quarter of an ounce of eggs.

mosphere in which the eggs are kept should neither be too dry umid. M. Beauvais found a saturation of 50 per cent. to be the table condition of the air, as when it is below that point the f the egg evaporate so rapidly as to require a highly saturated ere for their incubation. Excessive moisture, on the other hand, st the formation of mold, which will quickly injure the contents g. The eggs should be frequently inspected, and whenever d is discovered it should be quickly brushed off and the eggs to a drier locality.

natural conditions the egg undergoes a partial development as laid, as shown by its changing color. After oviposition, and jected to cold, the eggs of the annual races are not capable of out. This is the rule, although we often find in a batch of an- s a few accidental bivoltins that hatch some fifteen days after laid. The number, however, is very slight, and it has been de- that the temperature to which they are submitted in no way s result. During this period, which we will call prehibernal, l be kept at any ordinary temperature, however warm, but e submitted to the cold of winter a certain change takes the nature of which has not as yet been determined, and nt warming may then result in hatching. As in our u days are quite frequent in late winter, it becomes of the

greatest moment that the eggs be kept below the hatching temperature until the foliage on which the worms are to feed is developing and all danger from late frosts is at an end. The period of hibernation may be lengthened by keeping the eggs in a cool, dry cellar, with a northerly exposure, and in general this will suffice. But in such a case the temperature is more or less variable, and the embryo may have been started in its development only to be checked by renewed cold. When kept at a uniform low temperature, after having once been cooled, development is imperceptible, and when afterward exposed to the proper hatching conditions, the resultant worms will prove more vigorous. Some experiments made in Italy during the last few years seem to indicate that additional vigor will be imparted to the race if the eggs are kept at a rather high temperature during the prehibernal period, and that it may be well to prolong this period artificially up to the first of January.* These experiments, however, have led as yet to no wide application of the process.

When small lots of eggs are to be wintered, they may be placed in ordinary boxes in the cellar, care being taken to observe the precautions noted above as to ventilation, humidity, and temperature. They should also be protected from rats, ants, and other vermin. But where great quantities are to be stored it will be well worth while to construct special hibernating boxes, where the requisite conditions may be regulated with nicety and precision. Such an one has been constructed during the past summer for this office, and it is hoped by its aid that eggs may be kept from hatching until well into the summer. It is unnecessary, however, to give a description of it here, though in our next annual report it may prove worth while to summarize the results obtained from eggs wintered in it.

In preparing this article, we have profited largely by the work of M. Pasteur upon the diseases of Silk-worms, and upon the "Lessons" of M. Maillot, director of the French sericultural station at Montpellier. We would recommend this latter work to the careful attention of all silk-raisers acquainted with the French language. On account of their excellence we have copied from Pasteur the figures of Plates II and III, and from Roman's "Manuel du Magnanier," Fig. 1, of Plate IV.

MISCELLANEOUS INSECTS.

DESTRUCTIVE LOCUSTS, OR "GRASSHOPPERS."

Order ORTHOPTERA; Family ACRIDIDÆ.

These insects have occupied rather more than their usual share of notice during the year, as there has not only been a good deal of injury throughout the Atlantic States by non-migratory species, but special devastation on the Pacific coast, as also in parts of the Northwest.

THE ROCKY MOUNTAIN LOCUST.

(*Caloptenus spretus*, Thomas.)

In a paper read before the late meeting of the American Associ for the Advancement of Science, we remarked that "plausible theo

* See article of Victor Rollat, copied from *Il Bacologo italiano* into *Le Monit* ... Lyons, October 17, 24, 31, and November 7, 1885.

rated to show that there is a certain periodicity in locust
a connection with such visitations and sun-spots. How-
, no one cognizant of the facts can doubt the connec-
we rious locust injury and business depression, or that there
cer n periodicity in wide-spread locust injury, averaging
very ele years. This last fact may explain the exceptional
ness and anxiety which locust increase has this year caused
the farmers of the trans-Mississippi, as more than the average
past since the last serious devastations began and just a
ice their height was reached."

ave each year, since the Government investigation of the species
n 1877, endeavored to accumulate sufficient data to predicate
e possibilities for the ensuing year, though, as stated in our
nual report, absence from the country and other reasons pre-
our doing so in 1884.

ts came quite early in the season of great abundance of young
hatching out in the Platte Valley country, and they were suffi-
serious to justify our sending out one of the agents of the Di-
. Lawrence Bruner, to make investigations and ascertain the
ns reports proved that the fears were groundless, as the young
referred to proved to be what are known as native or non-migra-
cies which were unusually numerous. Later in the season, how-
orts came of injury by, and increase of, locusts in parts of the
st, and an investigation ordered of these reports proved that
ety felt by the people of the Northwest had more real founda-
Mr. Bruner's report of this investigation, which will be found
he reports of agents, shows that not only were the non-migra-
cies very abundant, but that this particular *spretus* had greatly
d in numbers and was moving in flights to the South and South-
here is no doubt but that considerable areas within that country
en stocked with eggs, and, should the weather prove favorable
development, there may be considerable injury done in 1886,
arly since Mr. Bruner noticed a scarcity of natural enemies. But
one encouraging side to this rather foreboding outlook, viz, (1)
heavy rains and storms which prevailed there last autumn
judicial to the insects, and (2) that under the most favorable con-
o locust increase, the injury, for the various reasons given in the
Report of the United States Entomological Commission, and
he advance of settlement and cultivation, can never be as wide-
s it was between 1874 and 1877.

THE CALIFORNIA MIGRATORY LOCUST.

(*Melanoplus devastator* Scudder.)

ly in May the correspondence of the Division and the reports in
showed that the people of California were becoming alarmed
nusual injury being caused by some locust in California. The
as done more particularly in the northern portions of the State,
ecially in the San Joaquin Valley. At first there was a good
loubt as to what species was concerned in this injury, and not
cimens had been received by us from Profs. C. H. Dwinelle and
rd and from Mr. C. W. Brooks, was the species properly
o be the *Melanoplus devastator* (Plate VIII, Figs. 1, 2, 3, 4,
ecimens were from Fresno and Yuba Counties, and in-
w other species, associated incidentally with *devastator*,

and notably *Caloptenus differentialis*, a species occurring from lantic to the Pacific, and which, though ordinarily sedentary, is c under exceptional circumstances of extended flights.* Feeling t portance of the subject to the California people, Mr. D. W. Coq of Anaheim, was commissioned and instructed to make a thoro vestigation of the occurrence cited.

Mr. Coquillett's report is included among the reports of agent it will be unnecessary, therefore, to go into any details here. Mr.. Koebele was also commissioned to make observations at Folso some notes from him are also added.

We may remark, however, that although Mr. S. H. Scudder, original characterization of *Melanoplus devastator*, correctly inferr this species "probably, rather than *M. atlanis*, is the source of m the damage to crops in California,"† yet this is the first year in it has been reported and recognized as an injurious, and at th time migratory, species. In considering the injurious species Pacific coast, in the First Report of the United States Entomo Commission, this species was not mentioned. Subsequent i showed, on the contrary, that *Camnula pellucida*, Scudder, was th culprit.‡ In fact, this was the species that did the injury in 18 1879, as will be seen by the correspondence with Mr. J. G. Lem Sierra Valley, Cal., and by other data, recorded on pages z of the Second Report of the Commission. The specimens trans to us from Sierra Valley and other places in 1878 and 1879 by M mon proved to be *Camnula pellucida*, but a few specimens of a species which Mr. Lemmon calls "a suspicious species, which I *Caloptenus atlanis*," proved to be *M. devastator*. This last was als by Dr. Packard on his Western trip in 1877, and is figured on Pla Figs. 2, 3, 19, and 20 of the Second Report of the Commission.

It was rather remarkable, therefore, to find *Melanoplus devasta* chief culprit the present year. For, while other species, some o common to the Atlantic coast, as will be seen by Mr. Coquille port, were also concerned in the injury, this was by far the n merous, as the observations of all correspondents and the spe received bear evidence. This species is really the Pacific coast sentative of our Rocky Mountain species, or *M. spretus*, and i many of the longer winged specimens resemble it so closely tha not surprising that the first references to its injury the presen were under this name.

In all essential particulars the habits of *devastator* are identic those of *spretus*.

Geographical Range.—Mr. Scudder, in his original character (*l. c.*, p. 46), records it as "being especially abundant in the Shas ley, and found also at Sisson's (Packard) and Sauzalito, Cal. (Be occurs about Lake Tahoe, Reno, and Glen Brook, Nev. (Packard was taken by myself sparingly at Beaver Brook and Morrison The specimens we received in 1879 from Mr. Lemmon came from Valley, Sierra County, California. Mr. Bruner, in his "First co ion to a knowledge of the Orthoptera of Kansas," p. 138,§ records t

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* See our Seventh Annual Report on the Insects of Missouri, pp. 153–155; al xviii, First Report United States Entomological Commission

† Entomological Notes, vi, p. 46, reprinted from Proceedings Boston Society ral History, vol. xix, 1877–'78.

‡ Second Report United States Entomological Commission, chapter xii, "Lo ges in California," pp. 242, ff.

§ Washburn Coll. Biol. Survey of Kansas, 1885.

s from California and adjoining portions of Oregon; also occurring roughout Montana, in northern Dakota, in Idaho, and northwestern 'yoming. He also refers to this species a single pupa found by Mr. . W. Cragin at Garden City, Kans. The localities in California from hich we received the species during the past year are as follows: rysville, Yuba County; Sanders and other points in Fresno County; n, Amador County; Napa Valley, Napa County; Atwater, Mer- County; Folsom, Sacramento County; Valley Springs, Calaveras y.

acters of the Species.—Even to an experienced entomologist it a matter of extreme difficulty to distinguish among themselves e three most destructive and migratory species of *Melanoplus* so far own to occur in the United States. We have already set forth and red in detail the distinguishing traits between *spretus* and *atlanis*, u *devastator* is in many respects intermediate between them. In fact, e chief distinguishing characters of importance and constancy are to f d in the structure of the abdomen in the male sex. The follow- are the differences in the cerci as tabulated by Mr. Scudder:*

cerci slender, equal, straight, nearly four times as long as broad... *M. devastator.*
cerci broad, rarely more than three times as long as broad, the apical half bent on the basal:
Anal cerci more than twice as long as broad..... *M. atlanis.*
Anal cerci less than twice as long as broad..... *M. spretus.*

Slight as these differences may appear, yet experience has shown at the secondary sexual characters are by far the most persistent of external characters that can be observed in these insects and in , in most insects. In the present state of entomological classifica-

n we are justified in regarding as distinct, and entitled to be ranked "species," such forms as show well-marked secondary sexual char- s, even where all other characters are evanescent in large series of ns.

n general appearance and colorational characters *devastator* is so like *spretus* that it is not worth while to specify differences, espe- y since the color is a very variable quantity in these insects, that of tibiæ in all three species under consideration varying from blue to l, and in some specimens even being greenish. In general, *devastator*, pared with *spretus*, has the colors more strongly contrasting, espe- y the vittæ on the outside of the hind thighs; and, as Mr. Scudder s pointed out, the pronotum seldom has a distinct black band at the per part of the deflected lobes, and the wing-covers may be abso- ely immaculate, or may have a very distinct series of discal quadrate ts. *Devastator* varies a good deal in size, and the wings also vary atly in length, but while they often fail to reach the tip of the body, y rarely exceed it more than one-fifth their length in the male; ereas, in *spretus* they more often extend in the male about one-third ir length beyond.

here are, however, some other structural characters, which permit of aration of these three species. All of them having the tip of the joint notched are readily distinguished from *femur-rubrum*. In er to set before the general reader more carefully than can be done lescription or table the variations in the structure of the anal parts which these species can be determined, we have reproduced from the port of the Entomological Commission the figures of those parts e (Plate VIII, Fig. 6), and of *atlanis* (Plate VIII, Fig. 7), which can

* Entomological Notes, &c., vi, p. 47.

be compared with those given for the first time of *devastator* (Plate Fig. 5). In a general way *devastator* may be distinguished fr others by the following characters: Cerci slender, more than thr long as broad, not narrowed at tip, but excavated at outer third; nearly resembling those of *atlanis* than *spretus;* supra-anal plate narily with the median ridges suddenly terminating and uniti posterior third; tooth-like appendages at base narrow, and r hi an average, to nearly one-half the length of the plate; in this ıt acter it more nearly resembles *femur-rubrum* than either *spr atlanis.* The turned up anal joint is usually less swollen than in *sp* and less narrow towards the tip than in *atlanis,* which has the notc deep and the two lobes not so well defined.

On examining a large mass of material it will be found that tl variation even in these structural details, and while it will be bot rect and more in accordance with modern ideas of species among mologists to rank *devastator* as distinct, we are ourselves more in to look upon *devastator* as a mere geographical race of *spretus.* ever, it is immaterial whether these forms be called races or d: species. We would refer those interested in further discussion subject to the remarks on *spretus*, *atlanis*, and *femur-rubrum* i Seventh Report on the Insects of Missouri, pages 169–171. On clusion that can be safely drawn from the study of large mate these allied species is, that no one individual, nor a few individual suffice to properly distinguish the forms. It is by a total aver the differences as they present themselves in large series that th cies are best indicated and characterized.

Remedies.—In corresponding with those interested we recomm the means that have been found most effectual against the unfl insects in the Mississippi Valley States as set forth in the first an ond reports of the Commission. These include burning, ditchin the use of kerosene or coal-oil pans. A new method of warfare ac in California and set forth by Mr. Coquillett consists of the use o nic, sugar, bran, and water, the proportions being one part by v of arsenic, one of sugar and five of bran, to which is added a c quantity of water. The arsenic and bran are first mixed togethe the sugar is dissolved in water and added to the bran and arsenic which a sufficient quantity of water is added to thoroughly wet th ture.

About a teaspoonful of this mixture is thrown upon the grou the base of each tree or vine, and left to do its work. The poison slowly, seldom killing its victim within less than eight or ten hour having been eaten.

We have already expressed the belief in articles that have bee lished that this method of destroying the locust will prove very iceable in orchards and gardens where the insects are not abu but we do not think it will compare with the other methods men in the Commission's reports where the insects are as numerous a have been in past years in the Mississippi Valley.

NON-MIGRATORY SPECIES.

As but few of the reports on locust injury in the Atlantic Stat accompanied by specimens, it is impossible to say what par species caused the damage in each particular case, but the spe eceived this year from various widely different localities, in di States, are all referable to three well-known species, viz, the Red-

(*Melanoplus femur rubrum*, De Geer), the Differential Locust *oplus differentialis*, Walker), and the Two-striped Locust (*Melan-ivittatus*, Say).

Lesser Locust (*Melanoplus atlanis*, Riley), of which we gave an t in our annual report for 1883* in relation to its ravages in the c Valley, New Hampshire, does not seem to have attracted ıttention in 1885, though the following newspaper item doubtless :o this species:

ıoppers are doing considerable damage to crops, particularly oats, in some of New Hampshire" (*New England Farmer*, July 25, 1885).

other reports of locust injury in 1885 come from regions where sser Locust is not likely to be the predominant species, and where ncipal damage has evidently been done by the one or the other three species above mentioned.

Red-legged Locust is one of the commonest and, at the same ıost widely distributed species, ranging from the Atlantic to the coast and from Mexico and Florida to British Columbia and the n Bay Territory. In the more hilly and mountainous sections of lantic States, and more especially in the New England States, usually predominates; while in the States west of the Alleghany ains *femur-rubrum* is by far the commonest species. This year, the most abundant species in parts of Kansas.† Further west, home of the Rocky Mountain Locust, Mr. Bruner does not men- among those "native" species which were common the past in Colorado, but further north, in the vicinity of Glendive, Mont., ıd, July 31, large numbers of *femur-rubrum* which, however, were merous than the Rocky Mountain and the Lesser Locusts which ed in the same region and at the same time.

hree of the species mentioned were reported as quite destructive s of Iowa, while *differentialis* proved extremely destructive and no little alarm in parts of Arkansas.

THE PERIODICAL CICADA.

(*Cicada septendecim*, L.; and race *tredecim*, Riley.)

Suborder HOMOPTERA; Family CICADIDÆ.

[Plates I and V, and Fig. 1, Plate VI.]

interesting insect attracted more than usual attention during year by virtue of the fact that two extensive broods appeared, cupied large areas of the country east of the Mississippi River. ı a view of meeting the largely increased demand for information he subject, as also with a view of getting as accurate information le about the distribution of the two broods that were to ap- re published, the latter part of May, Bulletin No. 8, on the Peri- Cicada, being a popular illustrated account of the insect, and ly of the different broods that appear in different years and that ıar known. As a revised edition of this bulletin is in prepara- e shall confine our remarks here to some phases of the insect's

of the Commissioner of Agriculture for the year 1883, pp. 170–180; Plates II, IX.

to Mr. F. W. Cragin, in L. Bruner's "First Contribution to a Knowl- ptera of Kansas," p. 137.

history, habits, and development that interest the large farming constituency to which this annual report is addressed. In doing this we shall reproduce some passages of the bulletin referred to, placing the passages in quotation marks. We shall also quote from some of our writings on the subject at the time the insect was appearing.

A SEVENTEEN-YEAR AND A THIRTEEN-YEAR RACE.

In 1868 the writer announced the existence of 13-year broods of this insect, in addition to the 17-year broods, one of which has been very thoroughly recorded ever since the earlier part of the seventeenth century. At the time we made this announcement in the *Journal of Agriculture* of Saint Louis, for June, 1868, we were not aware that any one else had made similar observations. Four months later, however, we learned, as stated in the First Annual Report on the Insects of Missouri, that Dr. Gideon B. Smith, of Baltimore, Md., had made similar discoveries, though he had never published the facts, which had been collected in an unpublished manuscript. This had been kindly copied for us by Dr. J. G. Morris of the same city. As set forth in a note to Bulletin 8 5, 6) we became aware, five years later, that Dr. D. L. Phares, of W ville, Miss., had even anticipated Dr. Smith in this discovery, in so as one of the broods is concerned, and from correspondence with Dr Phares, as well as from personal interviews with him on the subject, i would appear that Dr. Smith really obtained his information fr Dr Phares. To the latter, therefore, belongs the discovery of one or tu 13-year broods of the Cicada, and the credit of having first publ the facts, though, unfortunately, no record of the publication other than his own memory is now to be obtained.

TWO DISTINCT FORMS OR VARIETIES; SPECIFIC VALUE OF THE DIFFERENT FORMS.

"It is not a little singular also that two distinct forms occur in both races—a large one and a small one—the former by far more numerous than the latter. This fact has been observed in past years, and was noticed in 1868 by independent observers in different parts of the country. Indeed, it was observed by Dr. Hildreth, of Marietta, Ohio as far back as 1830 (*vide Silliman's Journal*, xviii, p. 47). The t *Cicada septendecim* of Linnæus (Pl. VI, Fig. 1 *A*, ventral view of as described by Harris and Fitch, occurs in the greatest numbers, both in the 17- and 13-year broods. It will measure, on an average, 1½ inche from the head to the tip of the closed wings, and almost always expand over 3 inches. The whole under side of the abdomen is of a dull orange brown color, and, in the male more especially, four or five of the segments are edged with the same color on the back.

"The other form (Pl. VI, Fig. 1 *B*, ventral view of male) is not, on a average, much more than two-thirds as large, and usually lacks entirel the dull orange abdominal marks, though there is sometimes a faint trac of them on the edges of the segments beneath. This small form was described in 1851, by Dr. J. C. Fisher, in the Proceedings of the Philadelphi Academy of Natural Sciences, vol. v, pp. 272, 273, as a new species Cicada, hitherto confounded with *septendecim*, and was named *Cicad assinii*. His description was followed by a note from Mr. John Cassi n which the latter states that the two forms show no disposition t associate together, and produce very different cries. The fact of very great difference in the song of the males has been fully confi

observations of M. C. Hill, of northeastern Ohio, who likewise
n that the small form is very much less numerous than the large one.
" tr test of the specific distinction of these two forms lies in
ave shape of the male genitalia, and the accompanying
igures (*c*, *a*, *e*, and *f*, in Fig. 1, Pl. VI), from drawings made in 1868 by
)r. H. A. Hagen, of Cambridge, Mass., show the male genital hooks of
oth. That of *septendecim* is represented on the outside at *c*, on the in-
ide at *d*; and that of *cassinii* on the outside at *e*, and on the inside at *f*.
"By these figures it will be seen that there are sufficient differences
o separate the two forms as distinct; but while the hooks of the large
ind (*septendecim*) are quite constant in their appearances, those of the
naller kind (*cassinii*) are variable, and in some few specimens are in-
listinguishable from those of the large kind. The circumstance, coupled
ith the fact that the small kind regularly occurs with both the 17 and
3 broods, would indicate it to be a dimorphic form of the larger,
only entitled to varietal rank.
"The large form has been observed to make its appearance from eight
o ten days earlier than the small form (*cassinii*), and there is not a
ingle specimen of the latter among a number of the 13-year brood
i *cim*) that I captured in May, 1868, though I took a few specimens
ard."
ne *septendecim* and *tredecim* forms have been looked upon by some
riters as constituting distinct species, notwithstanding their external
ice. There are absolutely no differences observable in the in-
constituting the different broods other than the difference of time
equired for underground development.
The species should be catalogued thus:

Cicada septendecim Linn.
Race *tredecim* Riley.
Dimorphic variety *cassinii* Fisher.

Our correspondence shows that there is an astonishing confusion as
o the relation of the two varieties with the periodic or *septendecim* and
redecim races. Many observers, and even well-known entomologists,
ave taken the varieties to represent the races; and it cannot be too
trongly urged, because of the important bearing of the facts on cor-
chronological information, that while the variety *cassinii* can al-
ays be distinguished from the typical form, the two races include both
arieties, and are absolutely indistinguishable, except for the different
eriods of larval existence.

THE LONG PERIOD OF UNDERGROUND DEVELOPMENT.

The quoted passages which follow are from a paper read by us at the
eeting of the Biological Society of Washington for May 30, 1885, and
ubsequently published in part in the *Scientific American* (June 27, 1885,
Suppl.) and *Science* (June 25, 1885, vol. v, p. 518–521).
"From chronological data the fact that seventeen years or thirteen
s are respectively required for the underground development of this
, according to the race, is fully established, one of the first recorded
ecim broods having been observed every seventeen years since
ua. Such anomalous and exceptional facts in natural history, as wit-
he discussion as to the egg-laying of the *Ornithorhynchus*, always
kepticism, and the facts recorded regarding our Cicada's hypo-
i have shared in this tendency. Hence a few biologic facts,
v such as bear on the development of the larva, will not prove
ng.

"I took pains to follow the larval development as far as possibl year to year, of the *tredecim* brood which appeared in 1868, my vations having been made in Saint Louis County. Repeated eff rear the young larvæ in confinement proved unsuccessful, and necessary to resort to careful and repeated digging in order to the growth from year to year. One of my employés, at Cadet, M also been instructed to carefully pursue the same subject, and repeated the digging since residing in Washington. These observ have in all cases been made in special localities where the date of ing the ground was well known and observed. I have thus bee to follow the larvæ for the first six years with great care, and fc sequent years with less care and continuity. As we might expec the chronological history of the species, the development of the la extremely slow, and at six years old it has hardly attained one-fou full size. Another interesting result is that notwithstanding thi development, molting takes place quite frequently, *i. e.*, the num larval stages is more than one per annum, and probably twenty- thirty in all; whereas in Homoptera generally—the suborder to the Cicada belongs—it ranges from two to four. In any hypog sect which continually uses its claws in burrowing, the need of she and renewing those organs is apparent and may afford the chief nation of this repeated exuviation, though the slow developmer factor, since my own experience has shown in the larvæ of other C that in proportion as development is slow, exuviation is frequent changes with each molt are, in our young Cicada, most noticeable antennæ and in the front legs and their armature, for the genera undergoes but little change, the body very gradually shortenir thickening, and the color darkening with age.

THE FOOD OF THE LARVA.

"A good deal of difference of opinion has been expressed by ent writers as to the food of the Cicada larva, and this is not wondered at, from the fact that there is great difficulty in obser feed. Dr. G. B. Smith insisted that it obtained its nourishmen the moisture of the earth through capillary hairs at the tip of th boscis, while others have seen it with its beak inserted in the r trees and pumping the sap therefrom. My own observations in that both methods of obtaining nourishment may obtain. The method I have never witnessed, but it is insisted on by Dr. Smith his own observations, and receives support from the well-know that this Cicada will issue from ground that has been cleared of and cultivated for nearly seventeen years, and that other speci known to issue from the prairies. The truth of the matter seem that the Cicada can and does go for long periods without nourish where such fasting is necessitated, and that in the earlier years development, more particularly, it feeds on the rootlets or radice alone of trees, but of herbaceous plants. In my own observat have rarely found it more than 2 feet below the surface during th six or seven years of its life, and almost invariably in an oval ce more often away from roots than near them. Yet I have also fo with beak inserted, and it will often hang fast by the beak after unearthed. That the larva is capable of going to great depths se be well attested by observers, and I have recently received a c cation where the writer says he has found it 20 feet below the s

"It is difficult to say how many of such reports are based

:ved tumbling of the larva from higher levels, but where the in-
ıve been observed to issue from the bottoms of cellars 10 feet
ıe information would certainly seem to be reliable.

METHOD OF BURROWING OF THE LARVA.

method of burrowing and of making its cells is quite interesting.
ches away the walls of its cell with the tarsal claw just as one
lo with a pick, and if it is rising so that the earth removed natu-
lls to the posterior end of the burrow, it simply presses the de-
portions on all sides, and especially on the end of the cavity, by
of its abdomen and middle and hind legs. If, however, it is
ng downward and the loose soil has to be pressed against the
he cavity, it uses its broad front femora very dexterously in
a little pellet of the soil and in placing it on the clypeal or
of the head, when the load is carried up and pressed against
or the cavity.
motions made in cleaning its forearms remind one very forcibly
: made by a cat in cleaning its face. The femora and bent tibiæ
)ed over the clypeus, the numerous stiff hairs on which act like
or brush in freeing the spines of dirt.

THE TRANSFORMATIONS.

[Plate I.]

he time approaches for the issuing of the pupa, it gradually rises
ınd nearer to the surface, and, for a year or two before the ap-
e of any given brood, this pupa may be dug up within one or
: of the surface.
he year of their ascent, from the time the frost leaves the ground,
: found quite close to the surface, and under logs and stones,
; to await the opportune moment, and apparently without feed-
ıey begin to rise from about the 20th of May in more southern
's, and but little later further north. Here, in Washington, the
year, they begun to sparsely issue about the 23d, and were, per-
ıost numerously rising on the night of the 27th. Those in the
'e somewhat earlier than those in the woods just over on the Vir-
de. The unanimity with which all those which rise within a cer-
lius of a given tree crawl in a bee-line to the trunk of that tree
interesting. To witness these pupæ in such vast numbers that
not step on the ground without crushing several, swarming out
· subterranean holes and scrambling over the ground, all con-
; to the one central point, and then in a steady stream clamber-
the trunk and diverging again on the branches, is an experience
dily forgotten, and affording good food for speculation on the
of instinct. The phenomenon is most satisfactorily witnessed
here is a solitary or isolated tree.
) pupæ (Pl. I, Figs. 1, 2) begin to rise as soon as the sun is hidden
the horizon, and they continue until, by 9 o'clock, the bulk of
'e risen. A few stragglers continue until midnight. They in-
ey crawl along the horizontal branches after they have ascended
k, and fasten themselves in any position, but preferably in a
position on the leaves and twigs of the lowermost branches.
hour after rising and settling, the skin splits down the mid-
norax from the base of the clypeus to the base of the meta

notum (Pl. I, Fig. 3), and the forming Cicada begins to issue. Ecdysis is always an interesting phenomenon, and, when closely watched in our Cicada, cannot fail to entertain.

"The colors of the forming Cicada are a creamy-white, with the exception of the reddish eyes, the two strongly contrasting black patches on the prothorax, a black dash on each of the coxæ and sometimes on the front femora, and an orange tinge at base of wings.

"There are five marked positions or phases in this act of evolving from the pupa-shell, viz, the *straight* or extended, the *hanging*, head downward; the *clinging*, head upward; the *flat-winged*, and finally the *roof-winged*. In about three minutes after the shell splits, the forming imago extends from the rent almost on the same plane with the pupa, with all its members straight and still held by their tips within the exuvium (Pl. I, Fig. 4). The imago then gradually bends backwards and the members are all loosened and separated. With the tip of the abdomen held within the exuvium, the rest of the body hangs extended at right angles from it, and remains in this position from ten to thirty minutes or more, the wing-pads separating, and the front pair stretching at right angles from the body and obliquely crossing the hind pair (Pl. I, Figs. 5, 6); then gradually swell, and during all this time the legs are becoming firmer and assuming the ultimate positions. Suddenly the imago moves upward with a good deal of effort, and clinging with its legs to the nearest object reached, whether leaf, twig, or its own shell, withdraws entirely from the exuvium and hangs for the first time with its head [illegible] (Pl. I, Fig. 7). Now the wings perceptibly swell (Fig. 8) and expand until they are fully stretched and hang flatly over the back, perfectly transparent with beautiful white veining (Fig. 9). As they dry they assume the roofed position (Fig. 10), and during the night the natural colors of the species are gradually assumed (Fig. 11).

"The time required in the transformation varies, and, though for the splitting of the skin and the full stretching of the wings in the flat position the time is usually about twenty minutes, it may be, under precisely similar conditions, five or six times as long. But there are no more beautiful sights than to see this fresh-forming Cicada in all its different positions, clinging and clustering in great numbers to the side lower leaves and branches of a large tree. In the moonlight such a tree looks for all the world as though it were full of beautiful white blossoms in various stages of expansion.

THE CICADA VERSUS CIVILIZATION.

"That this insect, in its distribution and in its numbers, has been and is being seriously affected by our civilization must be apparent to every observer. The records show that the numbers have decreased in successive appearances of certain broods, owing largely to the presence of our domestic animals in the woods. Then, again, the clearing of land and the building of towns and cities have all had their effect upon the increase of this Cicada. There are doubtless many places in Brooklyn, N. Y., where the insect appeared seventeen years ago in which there will be none the present year. And similarly I opine that, where around every tree that has been planted more than seventeen years ago upon land that grew trees seventeen years ago the insect is now abundant in Washington, it will scarcely be noticed in any part of the district seventeen years hence. I base this opinion upon a new phase in the Cicada history, viz, the presence of the English sparrow. It is the first time, perhaps, in the history of the world, that *Passer domesticus*

had an opportunity of feeding upon this particular brood of *Cicada ndecim*, and so ravenously and persistently does this bird pursue ood that the ground is strewn with the wings of the unfortunate da wherever these have been at all numerous; so that, considering numbers of the sparrow and their voracity, very few of the Cicada be left long enough to procreate and perpetuate the species in this rict."

THE SONG NOTES OF THE PERIODICAL CICADA.

ie following remarks upon this subject were communicated to *Science*, are reproduced from its issue of September 25, 1885.

:re are few more interesting subjects of study than the notes of s and the different mechanisms by which they are produced. interest every observant entomologist, and it is difficult to re- them in musical symbols that can be reproduced on musical in- uts, some of the more successful and interesting attempts in this :uon having been made by Mr. S. H. Scudder. I have studied ly the notes of a number of species, and have published some of bservations.*

n the notes of the true stridulators more particularly, as the com- tree crickets and katydids, I have been impressed with the varia- both in the pitch and in the character of the note, dependent on ge of the specimen and the condition of the atmosphere, whether moisture, density, or temperature: yet, with similarity in these itions, the note of the same species will be constant and easily rec- le.

. iew remarks upon *Cicada septendecim* will doubtless prove of inter- ow that the species has been occupying so much attention. I do nd that the notes have been anywhere very carefully described in l, nor would I pretend to put them to musical scale. Writing nteen years ago, I described the notes in a general way, as follows: The general noise, on approaching the infested woods, is a compro- between that of a distant threshing machine and a distant frog- . That which they make when disturbed mimics a nest of young or young birds under similar circumstances, a sort of scream. can also produce a chirp somewhat like that of a cricket, and a loud, shrill screech, prolonged for fifteen or twenty seconds, and nally increasing in force, and then decreasing.'†

'here are three prevalent notes, which, in their blending, go to make eneral noise as described above. These are:

'irst. That ordinarily known as the *phar-r-r-r-aoh* note. This is the most often heard during the early maturity of the male, and es- lly from isolated males or from limited numbers. It is variable in and volume, according to the conditions just mentioned as gen- affecting insect melodists. Its duration averages from two to seconds; and the *aoh* termination is a rather mournful lowering e general pitch, and is also somewhat variable in pitch, distinct- and duration. In a very clear atmosphere, and at certain distances, ridual note has often recalled that made at a distance by the ng of a rapid train passing under a short tunnel. But when heard nt proximity, the rolling nature of the note will undoubtedly most persons more of the croaking of certain frogs than anything I have heard it so soft and low, and so void of the *aoh* termina-

*Third Rep. Ins. Mo., 14, 153, 154; 4th do., 139; 6th do., 150–169.
†First Rep. Ins. Mo., 24.

tion, that it was the counterpart of that made by *Œcanthus latipennis*, Riley, late in autumn, and when shortened from age and debility of the stridulator.

"Second. The loudest note, and the one which is undoubtedly most identified with the species in the popular mind, is what may be called the 'screech.' This is the note described by Fitch as 'represented by the letters *tsh-e-e-E-E-E-E-E-e-ou*, uttered continuously, and prolonged to a quarter or half a minute in length, the middle of the note being deafeningly shrill, loud, and piercing to the ear, and its termination gradually lowered till the sound expires.' Dr. Fitch errs as to the length of its duration; and I have also erred in the same direction, less, indeed, there is a still greater range than my subsequent observations would indicate.* It is more probable, however, that our memories were at fault; for, as I have verified this year, this shrilling ordinarily lasts from two to three seconds, though occasionally longer, and is repeated at intervals of every five seconds. This note is rarely made by solitary males, or when but few are gathered together; but it is the prevailing note in the height of the season, and is made in unison; *i. e.*, the assembled males on a given tree, or within a given grove, are prompted to it simultaneously, so that its intensity becomes almost deafening at times. It is of the same nature as that made by the Dog-day Cicada (*Cicada pruinosa*, Say), and in its higher and louder soundings is not unlike the shrilling of that species, though by no means so sharp and continuous. It is what in the distance gives the threshing-machine sound, and it has often recalled what I have heard in a saw-mill when a log is being cut crosswise by a circular saw.

"Third. There is what may be called the intermittent, chirping sound which consists of a series of from fifteen to thirty, but usually about twenty-two, sharp notes, sometimes double, lasting in the aggregate about five seconds. This sound is so much like that ordinarily produced by the barn or chimney swallow (*Hirundo erythrogaster*), that a description of the one would answer fairly well for both. It resembles also, though clearer and of higher pitch, the note of *Microcentrum rhombifolium* Burm., which I have likened to the slow turning of a child's wooden rattle highly pitched. The above notes, so far as I have recognized them, are of higher pitch, but of less volume, in the smaller *canadensis* form.

"The other notes—viz, that made when the insect is disturbed; and a not infrequent, short cry, that may be likened to that of a chick—are comparatively unimportant; but no one could do justice to the note of this insect without embracing the three peculiar sounds which I have attempted to describe above, and which are commingled in woods where the species is at all common; though the undulating screech is by far the most intense and most likely to be remembered."

VARIATION IN TIME OF APPEARANCE.

It has long been known and well established that a few precursors may appear the year before, and a few belated individuals the year after, the regular appearance of any large brood. The exact causes for this exceptional variation in the development of a species which shows, on the whole, such remarkable uniformity in its life-history has not been definitely ascertained. The presumption is, however,

* "Since this was written, I have heard, on two occasions, this note prolonged for twenty seconds; but this is quite abnormal, and I have no other evidence than [illegible] (June 20) to prove that it came from *C. septendecim*."

iat variation is due to individual peculiarities rather than to ex-
rnai conditions, and it indicates that even in a species otherwise so
nifo in its periodical appearance there is, to a slight degree, that
ncy in individuals to vary which is so common an attribute of
t organisms. The retardation can perhaps be more readily ex-
than the acceleration; for the exceptional experience, alluded
on p ge 242, of retardation in the hatching of eggs when the egg
nctures are closed by exudation of gum from the twigs infested, indi-
ites one method by which individuals may be belated.

Whether accelerated or belated these stragglers have, so far as known, ppeared at the same season of the year that the main brood appeared. here is some evidence, however, that exceptional temperature, when rought to bear upon those pupæ that are already near the surface of ie ground, may accelerate the issuing of the imago. We have cited* ie case where Dr. E. S. Hull, of Alton, Ill., caused some Cicadas to as early as the 20th of March, in 1868, by constructing under-round flues for the purpose of forcing vegetables, and it is worthy of ng put on record here that Prof. Lester F. Ward gave his experience autumn of 1884, before the Biological Society of Washington, to ie ct that he heard the song of this Cicada in October of that year. here no other record of its ever having appeared during that month, nd though there is nothing impossible in the occurrence (and the ex-eptionally high temperature of October, 1884, would seem to render he occurrence even probable), yet the observation was unfortunately ased upon recollection and recognition of the song, and not upon ex-mination of the specimens or of their pupal exuviæ. There are so ny reasons for doubting the accuracy of observation so based that ie statement must be looked upon as untenable until verified by simi-ir but well-verified observations in the future.

ENEMIES OF THE CICADA.

When leaving the ground to transform, the pupæ are attacked by a mber of different quadrupeds and by birds as well as by many can-ibal insects, while in the perfect state they are also attacked by almost ll animals that can get access to them. Thus birds pursue them, es-ecially while they are yet feeble and before their wings become strong, nd, as we have seen, the English sparrow was particularly destructive) them in cities during this last visitation. Many of them, while still eble, and particularly those which issue from the pupa skins near the rface of the groumd, are attacked by reptiles and quadrupeds and redaceous insects. We have also detected a number of enemies of the gs, especially mites. These we shall treat of in detail in the proposed evised bulletin on the species. A fungus, the *Massospora cicadina*, Peck, also very commonly found infesting the perfect insect later in the sea-on when it has become enfeebled. This fungus is found in the shape f a yellow, brown, or clay-colored powder permeating all parts of the and often entirely filling the abdomen, and though found in the it is most frequently noticed in the male.

THE SUPPOSED STING OF THE PERIODICAL CICADA.

reports of stinging by this insect were not so common during ing year as during the appearance of other broods in years

* First Rep. Ins. Mo., 1868, p. 22.

gone by. While a number of instances have been reported, we have been unable to get any information of a reliable character that would tend to alter the conclusions to which we came in 1868, and which were published in the Cicada bulletin. These were, substantially, that while in the latter part of the season a severe sting may be inflicted by some hornet (genus *Stizus*) flying against a person while carrying a Cicada intended for burial in the ground as food for its young, yet it is more than probable that the sting results from the exceptional puncture by the beak or haustellum of the Cicada, the nature of the wound thus inflicted depending very largely on the condition of the system of the person punctured. All our experiments the past season seem to confirm the improbability that the ovipositor is used or can be used on human flesh for this purpose.

OVIPOSITION.

While there is a general impression among those who have not closely observed the facts that the female Cicada purposely severs or partly severs the twig upon which she has oviposited in order to cause it to break and die, no such opinion is held by any one who has carefully studied the facts. The nature of the perforation and the manner in which the eggs are inserted are well illustrated in Plate V, Fig. 1. So far from purposely severing or causing the severance of the egg-charged twigs, it is a fact that the eggs, in almost every instance, in twigs which have broken early or have fallen to the ground, shrivel up and fail to hatch. The breaking is merely accidental and confined to the small terminal twigs, and results from too close sawing or rasping, which weakens the wood so that it breaks with a strong wind. In tough wood the twig may be partly broken, and is then generally worn and twisted by the movements caused by the wind, as shown in our figure (Pl. V, Fig. 2). The proportion of severed or broken twigs or heavily charged twigs upon which the leaves prematurely die and dry, though it may be sufficient to give a withered appearance to the whole exterior portion of the tree, is but small compared with the thicker and stouter twigs which are punctured. In other words, 90 per cent. of the eggs, and probably 95 per cent. of those which hatch, are laid in twigs which never break.

We have observed some interesting instances of retarded development in the eggs of this Cicada when placed in the twigs of trees which exude some gummy substance, so as to hermetically close up the opening of the puncture and exclude the air. We have been surprised to find that such eggs, which would have normally hatched during the latter part of July, or about six weeks after being deposited, have remained sound, but unhatched, up to December, and long after the trees had shed their foliage.

INJURY WHICH CICADAS CAUSE TO FRUIT TREES—REMEDIES AND PREVENTIVE MEASURES.

This Cicada in its underground life has been charged with injuring and killing fruit trees. From what we have already stated as to its underground life—its long duration and its slow development—as well as for other reasons, such injury must necessarily be very trifling; this fact is borne out by some observations which we made the past summer. Even where the insects have been so thick in orchards the ground was absolutely honey-combed by their perforations, an inspection of the roots of these trees showed no injury, and in fact

y discoloration, even where the effects of the punctures were visible
m slight swellings or callosities.
In the perfect state, however, the female is capable of doing great in-
y to trees in ovipositing, and although this injury in the forest is
erial, it may become very serious in orchards, and is of still more
quence in the nursery.
naving tried fully, without success, in 1868, in Missouri, such insecti-
les as promised practical results in repelling the mature insects from
iit trees, we had not much hope of more satisfactory results from any
:ther trial. Yet we desired to test the effect and value of such in-
:ticide substances as have come into use since that time, and for that
ason planned and had a series of experiments executed. Most of
ese experiments were intrusted to Dr. W. S. Barnard, and we give
rewith the results:

Destruction of the Insects as they issue from the Ground.

Pyrethrum Powder.—This proved a perfectly satisfactory destroyer of
e Cicadas when freshly emerged and soft, and also when mature and
lened, both in the dry part of the day and when the dew was on them.
sy to puff this powder on them when on grass, weeds, and trees
morning before they gain full strength and ascend. At this time
of the insects are so low on the trees, or so near the ground, that
is y to make the powder reach them while standing on the ground.
is to be the most easy and convenient way of killing them. It
is thus applied to them on the lower branches and trunks, also to
oups of them collected and placed at stakes in the grass and at the
ses of uninfested trees. In each instance all except the pupæ died
it sooner or later. Oft-repeated tests showed it to be practically
rthless against the pupæ, for even when thoroughly coated with
wder they would give forth the perfect insect. But the winged insects
quite sensitive to the powder, showing marked irritation from it
thin five minutes after treatment. Though hanging quietly when pow-
uneasiness soon appears in the movements of the limbs and occa-
strokes of the wings against the sides. The movements of the
appear to be uncontrollable, so that in the course of a few hours the
falls helpless to the ground, where, though the movements may
nue for a whole day before death, a fatal termination is sure to
w. The powder was tested on ten different lots of Cicadas, includ-
about four hundred specimens (100 pupæ, 200 soft or forming adults,
ull-fledged adults).
In one experiment a ring of pyrethrum powder about one-eighth of
inch deep and 2 inches wide was placed on the ground around a tree
unk. The pupæ marched through this and ascended and molted with
ty; but the winged insects that had fallen, and others from the
ass on which they had emerged, were stifled by the pyrethrum as
ey tried to ascend the tree.
In testing the pyrethrum powder on pupæ, in most instances none
; but in two of the tests 10 per cent. of the pupæ died, but there
eason to believe that death resulted in these instances from hand-
nd collecting them in masses.
rum Water.—This was prepared in two ways, (1) by stirring
er as much pyrethrum powder as the water would suspend
t rest; (2) by adding milk (1 pint) to pyrethrum (4 fluid ounces),
vard diluting to suit. The milk, even when soured, holds all
ow in suspension, and facilitates its suspension in water.

(1) The simple water suspension of pyrethrum in four tests on pupæ was tried with a mortality of 10 per cent., but on the winged Cicadas, both soft and hard, it was thoroughly fatal, like the powder.

(2) Pyrethrum powder, one-eighth pint; milk, 1 pint; water, 16 pints, mixed.

Fifteen pupæ were treated with this with the following results: One disappeared, six died as pupæ, five died half emerged, and three emerged apparently uninjured. The same preparation sprayed on mixed lots of pupæ and winged forms, soft and hard, on trees and on the ground, had similar effects on the pupæ and killed all the winged insects.

In this way a very strong mixture of pyrethrum is applied, and it should be stirred just before using, when it will kill most of the pupæ as well as the emerged forms.

Kerosene Emulsion.—This was prepared after the usual formula and diluted with two parts of water.

Used on a mixed lot of pupæ and adults, soft and hard, one hundred of these on the base of an uninfested tree and fifty in the grass, 8 feet distant. In five minutes all seemed weakened: the pupæ still crept along a little, but the winged ones hung immovable on the tree or upon the ground, only moving their legs a little in a weak and he manner. A few minutes later the pupæ had stopped creeping. Thi was at 7 a. m. At noon they had not moved from their places, ex by a few having dropped from the tree, and all were either dead nearly so. The emulsion at once stopped all molting and transfor tion, and the soft wings hardened in shapeless forms. The same eff on the insects resulted in several smaller tests of the same strength o emulsion, though many of the insects were twenty-four hours in dying The pupæ were the slowest to succumb, but they were all destroyed b it in every instance and could not molt. Sprayed on them on the groun and as ascending or hanging on trees the same results followed, an this dilution of the emulsion seems the most thorough destroyer of th pupæ as well as of the emerging and winged Cicadas. From a whol pint of pupæ sprayed by this mixture not one succeeded in transforming

Small ants usually attacked some of the Cicadas that were struggling under the effect of pyrethrum or dead from it, but no ants were found affecting specimens treated with kerosene.

Other experiments were tried with the same emulsion, diluted as fol lows: (1) Emulsion, 1; water, 4; and (2), Emulsion, 1; water, 8.

The two strengths sprayed on groups of pupæ gave results varied from each other but little and killed nearly all; but some wer very slow to die and showed life even after two days.

Sprayed on the ground or the trunks of trees, these dilutions did not prevent the pupæ from ascending, and apparently had no effect on them except when sprayed on their bodies.

SUBSTANCES THAT KILL BY THWARTING EXUVIATION.

Dr. Barnard concluded from his tests that by communicating to retaining moisture or softness in the pupa skin, even the milk and wate in the preceding mixtures tend to render it difficult or impossible t cast the skin, and that they thus aid pyrethrum or kerosene.

Carbolic acid (2 per cent. solution).—This prevents the majority pupæ from molting, and they die sooner or later. For example, whe applied to one lot of pupæ at night, five were found in the morni dying or dead in a half-molted condition; seven were active, not molte and apparently not suffering; one was molted, but turned black by t ad and dead. In another case five dozen pupæ on the base of an

ıfested tree were sprayed with the same at night; none ascended the ee, and by the next noon four dozen were dead and dying. Tests on groups gave analogous results.

ıuis solution poured around the bases of trees had no influence in :tarding the pupæ, which marched over it unaffected and ascended the :ees.

Carbolic acid (1 per cent. solution) around trees also gave no result. :f the pupæ sprayed with this weak solution one-third were prevented :om molting and died.

Acetic acid (15 per cent. solution).—The results from this are very ıilar to those of carbolic acid of 2 per cent. strength. Applied in ne evening on a group of pupæ, the next day eight were active, six :ere half-molted and dying, three had emerged. Of the latter one was ead and covered by a swarm of small yellow ants. On other small ots the effects were similar; nearly all eventually died.

Acetic acid (10 per cent. solution).—This sprayed on four small lots of upæ prevented over one-half from emerging.

Alcohol (30 per cent. solution).—Sprayed on three lots of pupæ, about 0 per cent. were killed. They died very much as did those from acids in he foregoing cases. For example, one lot of two dozen pupæ was reated with the alcohol solution in the evening. The next morning lve were weak (dying), six were half-molted and dying, four were merged and dying, the others all right.

To prevent ovipositing.

E iments to repel the insects from trees and prevent the females ovipositing were made as follows: On the 20th of June the Cica- were numerous and active, depositing their eggs in a thicket of hes, which were low and hence easily inspected. On these the kerosene emulsion (60 per cent. kerosene) was tried to test its as a preventive. It was applied in different places in three ıns, viz:

	Parts by volume.
Emulsion	1
Water	2
Emulsion	1
Water	5
Emulsion	1
Water	10

The first dilution was so strong that it injured many of the leaves, and or was very distinct in the air among the bushes during the day of ıpplication, and still perceptible on the following day. The other ons had no effect on the foliage and from them no odor appeared, ept by scenting close to the surfaces treated.

Within two hours after the applications were made the Cicadas began ing again in the bushes which had been sprayed. During the ıternoon and in the forenoon of the next day ovipositing in these nes went on as rapidly as in those that had not been sprayed. The :ts were even driven off in the movements incident to the inspec- of the work, but at any time when not disturbed a few could be n inserting the ovipositor in the trees treated.

Further experiments were made with raw linseed-oil and with white- as preventives of this injury. Each of these substances was l upon the twigs of six young peach trees and on some lilac all of which had been much visited and more or less injured by Cicadas. But at the time of the application (June 22) the ecame cloudy, breezy, and cool, and so continued for some

time, so that the insects were less active than usual. After the cation a few Cicadas were noticed ovipositing, but none of them u bushes that had been treated. This experiment, therefore, is of tive value.

It is obvious from the foregoing that in pyrethrum and the ker emulsion, we have two valuable insecticides that may be used to a tage at the time the insects are issuing from the ground, but that n these substances, nor the others that have been so far tried, can l pended on, so far as experience has gone, when applied to trees, t tect these from the perfect insects when once mature and ovipos This is about the conclusion arrived at in 1868, and shows the i tance of anticipating the injury and of dealing with the Cicadas they are issuing from the ground.

CONSIDERATION OF THE TWO BROODS THAT APPEARED IN 1

With a view of acquiring as much exact information as p reference to these two broods, the following circular was sent the 1st of June:

Circular No. 16.] UNITED STATES DEPARTMENT OF AGRICULTURE,
DIVISION OF ENTOMOLOGY
Washington, D. C., June 1,

SIR: During the present year two large broods of the Periodical Cicada, or so "Seventeen-year Locust" (*Cicada septendecim* L.), one of the seventeen-year (*cim*) race, and one of the thirteen-year (*tredecim*) race, will make their appe different parts of the country.

I would beg you to glance over the following list of localities and to send n ing the season any confirmatory experience as to the appearance this year insects in those localities, or in any localities not indicated. Any evidence the extent of territory over which they appear in your county or State, or an attested dates of their appearance in previous years, will be thankfully recei appreciated:

BROOD VII.—*Tredecim* (1859, 1872, 1885).

Illinois.—Jackson, Union, Macoupin Counties.
Missouri.—Saint Louis, Boone Counties.
Georgia.—De Kalb, Gwinnett, Newton Counties.
Tennessee.—Madison County and northern portion of the State.
Mississippi.—Copiah County, Oxford, and eastern portion of the State.
Louisiana.—Carroll Parish.
Kansas.—Phillips County.
Arkansas.—Flat Bayou.

The existence of this brood has been verified in past years in the parts of I Missouri, Tennessee, Mississippi, and Arkansas indicated; but the localities i sas, Georgia, and perhaps Louisiana, require further confirmation this year.

BROOD XXII.—*Septendecim* (1868, 1885).

New York.—Kings, Monroe Counties.
Massachusetts.—Fall River, southeast portion of the State.
Vermont.—Oakland.
Pennsylvania.—Lancaster.
Ohio.—Greene, Franklin, Columbiana, Pike, Miami Counties, and vicinity of T
Indiana.—Tippecanoe, Delaware, Vigo, Switzerland, Hendricks, Marion, Dea Wayne, Floyd, Jefferson, Richmond Counties.
Michigan.—Southeastern portion.
Delaware.—Very generally.
Maryland.—Very generally.
District of Columbia.—Very generally.
Virginia.—Very generally.
Kentucky.—Around Louisville.
Georgia.—Habersham County.

Respectfully yours,

C. V. RILEY,
Entomol

number of letters have been received in answer to this circu-
ur knowledge as to the exact distribution of these two broods
:by been greatly increased. It is unnecessary to give this in-
in detail here, and we therefore merely summarize the facts in
ing enumeration of localities, the same order of States being
Where not otherwise stated the Cicada appeared in all coun-
ioned, and those which are additional to previous records are
een by comparison with the above circular list. It may be well
te that the previous simultaneous appearance of these two
in 1664, and that they will not concur again until the year

Brood VII.—Tredecim, 1885, 1898.

.—Jackson, Madison, Perry, Pike, Randolph, Scott, Union.
ve report from Saint Clair.
ri.—Audrain, Christian, Dade, Dallas, Douglas, Gasconade,
n, Greene, Hickory, Jefferson, Johnson, Knox, Lawrence (?),
lrid, Pettis, Perry, Polk, Saint Louis, Scott, Taney, Texas,
Washington, Webster.
ve reports from Cass, Daviess, Holt, Lewis, Monroe, Ozark,
toddard, Vernon.
.—Cobb (?), Coweta (?), De Kalb (?), Merriwether (?).
ve reports from Bibb, Carroll, Fulton, Glascock, Wilkes.
ky.—Graves, Trigg.
ve report from Livingston.
see.—Benton, Carroll, Chester, Crockett, Davidson, Decatur,
Dyer, Fayette, Gibson, Hardeman, Hardin, Haywood, Hen-
Humphreys, Lake, Lauderdale, McNairy, Madison, Maury,
obertson, Shelby, Tipton, Weakley.
ve reports from Bedford, Lincoln, Rutherford, Wilson.
ippi.—Alcorn, Amite, Bolivar, Calhoun, Carroll, Claiborne,
, Copiah, De Soto, Franklin, Hinds (and adjoining counties).
Jasper, La Fayette, Lawrence, Lincoln, Madison, Marshall,
ery, Newton, Panola, Quitman, Rankin (and adjoining coun-
tt, Simpson, Smith, Tate, Tishomingo, Webster.
ve reports from Clarke, Jefferson, Leake.
na.—Bossier, Caldwell, East Carroll, Franklin, Madison, More-
chland, Washington, West Carroll.
ve reports from Natchitoches, Rapides, Red River, Sabine,
oa, Vermillion, West Feliciana.
.—Negative reports received from eighteen counties (including
in eastern and central portions of the State.*
as.—Arkansas, Chicot, Columbia, Cross (and adjoining coun-
ha, Franklin, Izard, Jackson, Jefferson, Marion, Mississippi,
Prairie, Pulaski, Saline (?), Searcy.
ve reports from Crawford, Drew, Hempstead.

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urrence of Brood VII in Phillips County, Kansas, was based upon Dr.
hority, whose unpublished work on the Periodical Cicada, has, until lately,
ible to me only in a copy, which I owed to the kindness of Dr. J. G. Morris.
ion of Dr. Smith's original manuscript made during the past summer,
e courtesy of his daughter, Mrs. Elizabeth S. Gavet, revealed the fact that
itten "Phillips County, Arkansas." Thus the State of Kansas is to be
m the list of States known to be occupied by Brood VII and Phillips
be added to the localities in Arkansas.

Brood XXII.—Septendecim, 1885, 1902.

Massachusetts.—Negative report from Fall River (Bristol County).
Vermont.—Negative reports from Essex and Orleans.
Connecticut.—No reports received.
New York.—Kings, Richmond (?).
Negative reports from Clinton, Franklin, Genesee, Monroe, Ontario.
Rhode Island.—Negative reports from Bristol and Washington.
New Jersey.—Burlington, Camden, Mercer, Middlesex, Monmouth, Morris, Passaic (?), Somerset.
Negative report from Ocean (?).
Pennsylvania.—Adams, Blair, Bucks, Carbon, Chester, Cumberland, Dauphin, Delaware, Franklin, Huntingdon, Juniata, Lancaster, Lebanon, Lehigh, Mifflin, Monroe, Montgomery, Northampton, Perry, Schuylkill, Snyder, York.
Negative reports from Allegheny, Bradford, Butler, Columbia, Elk, Erie, Lackawanna, Luzerne, McKean, Monroe, Potter, Susquehanna, Tioga, Wayne, Wyoming.
Delaware.—Kent, New Castle, Sussex.
Maryland.—Alleghany, Anne Arundel, Baltimore, Cecil, Frederick, Garrett, Harford, Kent, Montgomery, Prince George, Talbot, Washington.
Negative reports from Calvert (?), Queen Anne, Somerset, and lower counties of the eastern shore.
District of Columbia.—Throughout.
Virginia.—Augusta, Carroll, Clarke, and adjoining counties, Fairfax, Frederick, Loudoun, Wythe, Spottsylvania (?), Warren.
Negative reports from Buckingham, Campbell, Grayson, Halifax, Hanover, Henrico, Highland, King George, Lancaster, Louisa, Powhatan, Prince William, Roanoke, Westmoreland.
West Virginia.—Berkeley, Grant, Hardy, Hampshire, and adjoining counties, Jefferson and adjoining counties, Mineral, Putnam (?).
Negative reports from Cabell, Calhoun (?), Gilmer, Lewis, Monongalia, Upshur.
North Carolina.—Caldwell (?), Cherokee (?), Davie, Lincoln (1834), Surry, Wilkes, Yadkin.
Negative reports from Alleghany, Gaston, Harnett, Hyde, Iredell, Jackson, Madison, Pasquotank, Wake.
South Carolina.—Negative reports from Abbeville and adjoining counties, Oconee, Williamsburg.
Tennessee.—Blount, Carter, Hamblen, Hamilton, James (?), Johnson (?), Knox, Loudon, McMinn (?), Polk, Scott, Sevier, Sullivan, Washington.
Negative reports from Bedford, Bledsoe (?), Bradley, Claiborne, and adjoining counties, Fentress, Lincoln, Meigs, Rhea, Rutherford, Unicoi.
Georgia.—Banks, Dawson, Fannin, Forsyth, Franklin, Gilmer, Habersham, Hall, Lumpkin, Pickens, Rabun, Union, White.
Negative reports from Columbia, Harris, Polk, Towns, Washington.
Alabama.—Saint Clair (?).
Negative reports from Blount, Limestone, Perry.
Ohio.—Adams, Butler, Champaign, Clarke, Clay, Clermont (?), Delaware, Fairfield, Franklin, Greene, Hamilton, Lucas, Montgomery, Pickaway, Preble, Sandusky, Warren, Wyandot.
Negative reports from Auglaize, Guernsey, Hardin, Jackson, Pauld[illegible] Seneca.
Kentucky.—Ba[illegible] Breckenridge, Carroll, Casey, Davies, Fayette (?),

klin, Hart (?), Henderson (?), Jefferson, Lawrence (?), McLean,
er (1868), Ohio, Oldham, Trimble.
gative reports from Casey, Clay, Leslie, Owsley, Pike, Russell and
ining counties, Shelby, Wayne.
diana.—The appearance of the Cicada was reported from all coun-
of the State, except the following:
e Kalb (not heard from), Howard (negative report received), Mar-
l (not heard from), Ohio (not heard from), Porter (negative report
ived), Pulaski (not heard from), Starke (not heard from).
linois.—Clark, Crawford, De Witt, Edgar, Edwards (?), Gallatin, Iro-
s (1868), Kane (?), Pope, Vermillion, Wabash, White, Williamson
haps Brood VII).
egative reports from Carroll, Douglas, Kendall, Lee.
ichigan.—Barry, Branch, Calhoun, Eaton, Genesee, Gratiot, Jack-
Kalamazoo, Lenawee, Livingston, Monroe, Saint Clair, Saint
h, Washtenaw, Wayne.
egative reports from Macomb, Manistee.
isconsin.—Sauk.
egative reports from a number of other counties.
he above enumeration of counties in which the appearance of the
a was reported to us in 1885, gives but an imperfect picture of the
ribution of the two broods, and we have, therefore, endeavored to
cate on a map (Map 1) the localities reported to us this year as
as those previously ascertained, and to thus illustrate graphically
extent of territory occupied by the two broods. The limited scale
map intended for an octavo volume prevents accurate and detailed
ieation of the limits of the territory known to be occupied by either
d as also the real conditions within that area. There are many
ities in which the Cicada appeared only in the northern or eastern
, or only in a few scattered localities, or even a single locality. All
and other details, so interesting and important for a thorough un-
nding of the geographical and topographical distribution of the
a, could only be indicated on a much larger map. It must also be
nbered that our knowledge of the distribution of the various
and more especially of the large ones which extend over many
es, is far from being complete. Many counties, especially in the
:hern States, have not been heard from at all, while the reports re-
ed from a number of other counties are so vague or so ambiguous
) be of little or no value.
oints of Contact of the two Broods.—A glance at the map shows
the two broods are well separated from each other except at two
ts, viz, in southern Illinois and northern Georgia. In the first-
)ned State the localities along the Mississippi River undoubt-
belong to Brood VII, while those along the Wabash River belong
equal certainty to Brood XXII; but considerable uncertainty ex-
regarding the localities along the lower course of the Ohio River
those between that river and the Mississippi. There is great
bt whether the county of Williamson, in Illinois, belongs to the ter-
y of Brood VII or to that of Brood XXII. We received two reports
that county, the one simply stating the appearance of the Cicada
ear, the second recording the Cicadas in the years 1868, 1881, and
These three years can only refer to Brood XVIII (1868 and 1881)
XII (1868 and 1885), both broods having appeared simultaneously
Thus, on the strength of this communication, we have referred
1 County, Illinois, to Brood XXII.
confusing and uncertain are the relations of the two broods

at their second point of contact, viz, in northern Georgia. The existence of Brood VII, in Georgia, is based upon Dr. Smith's unpublished "Register," in which he records the Cicada in 1846 and 1859 in the counties of De Kalb, Gwinnett, and Newton. In 1872 none of these counties were heard from, and in 1885 a single correspondent (Mr. E. M. Wynn, of Alto, Banks County) refers to two of them (De Kalb and Gwinnett), but in such a way as to connect them with the belt or belts undoubtedly occupied by Brood XXII in Georgia. Want of space prevents fuller consideration here of this interesting question, and for the present we leave these three counties attached to Brood VII.

In this connection we would finally mention that northeastern Alabama may also be claimed by either brood. All information received in 1885 from that State was of a negative character, excepting the following two statements: Judge J. F. Bailey, of Marion, has heard that the Cicada has been seen in June "in some of the counties in the northeast part of the State;" and Mr. John W. Inzer, of Ashville, Saint Clair County, had been informed by reliable authority that they had appeared in June in a specified locality in his county, but that he did not see them himself. In the absence of any previous record it is impossible to say to which of the two broods these two statements refer, and we have deemed it best at present not to mark the locality down on the map.

Geographical distribution of Brood VII.—Of the seven broods known to exist of the 13 year race, this Brood VII is only surpassed in extent by Brood XVIII (1881 and 1894), the remaining broods* being much smaller. Its main seat is the Mississippi Valley, extending northward a little beyond the thirty-ninth parallel, or a little north of the mouth of the Missouri, and southward a little beyond the thirty-first parallel. To judge from the sum of the records received in 1885 the brood is by far more generally distributed and more numerous on the east side of the Mississippi Valley than on the west side. Its most compact body is in Tennessee, where the Cicadas have been reported as extremely numerous in every county west of the Tennessee River. In Mississippi they were equally abundant in the section watered by the Yazoo River and its affluents from the northern line of the State south to Vicksburg, the brood then crossing the Mississippi and occupying several counties on the Louisiana side. Another distinct belt follows the Pearl River from the center of the State, extending into Louisiana. Between Pearl River and the Mississippi the Cicadas also occupied several counties; but the statement, derived from previous reports, that the brood is generally distributed through eastern Mississippi has not been corroborated; in fact, with the exception of the northeastern corner, nothing was heard of Cicadas in the eastern portion of the State. Southern Louisiana is entirely free from the Cicada (excepting localities along Pearl River), and the reported localities from the other sections form a compact one in the northeastern corner, and a smaller detached area in the northwestern corner along Red River, the locality being supported by another near by on the Arkansas side. In the latter State, as well as in Missouri, the reported localities, besides those along the Mississippi, are very much scattered and isolated; but since the Cicadas were, as a rule, not very numerous in the more northern sections, it is possible that the brood has not been generally observed, except by persons especially interested in this Cicada matter. In Illinois the brood occupies only counties along the Mississippi. From Kentucky the reports are remarkably scarce, but we ought to suppose the Cicada common between the

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*One or two of these are by no means so well established as could be desired.

ennessee and the Mississippi Rivers. In the southern part of the State is an eastward extension of the brood across the Cumberland River, nd this eastward extension is still more marked in Tennessee, where he Cicadas have been reported so far east and south as beyond Nashille. The entirely isolated locality, or rather group of localities in eorgia has already been referred to on page 250. The locality in Kanas formerly referred to this brood must be stricken off (see p. 247).

Geographical distribution of Brood XXII.—This is by far the largest f the fourteen broods of the 17-year race of the Periodical Cicada n to exist in the United States, and it is only equaled in extent by 13-year Brood XVIII (1881 and 1894). It extends from the Atlantic a to middle Illinois and Wisconsin, and, reaching in its northward on to beyond the forty-third parallel in Michigan and Wisconin, it nly attains, southward, the thirty-fourth parallel in Georgia. However, this immense area is by no means evenly occupied by the Cicada, and a glance at our map will at once show a very striking feature n its distribution, viz: It is divided into two large and sharply divided odies or branches. Detached areas of smaller or larger extent are of requent occurrence in the geographical distribution of the various broods, but in no other brood is the separation so striking as here. The elt separating the two branches, and in which consequently the Cicada not appear this year, is formed by the following territory: Western northern Pennsylvania, eastern half of Ohio, West Virginia west f the Alleghanies, central and eastern Kentucky, and a large portion f Tennessee.

The Eastern branch commences at Long Island,* New York, and, fola southwestern course, extends in small detached areas through ue New Jersey until, in Pennsylvania, we meet the compact main y of the brood which occupies the southeastern third of Pennsylia, the northern half of Delaware, the whole of Maryland (except the southern half of the peninsula between the Potomac and the eake Bay and the corresponding portion of what is known as he ern Shore), adjacent counties of West Virginia and the northernost counties of Virginia. From this point southward an extremely nteresting feature of the brood has been elucidated by this year's investigation, viz, that the Cicadas are entirely confined to the mountainus region, appearing nowhere in the open country east of the Alleghaies. Our records are not complete enough to decide whether the Cicadas occupy the valley of Virginia and adjacent portions of the Carolinas in a more or less complete body or in detached areas, but we re inclined to believe that the latter case will prove to be correct. At rate, in eastern Tennessee and northern Georgia, from which sec the records are more plentiful, the distribution of the Cicada eems to be governed by topographical features, the nature of which is till obsure, and the Cicadas are reported from numerous localities apearing either in strips, bordered by mountain ranges or streams, or in reas of smaller or larger extent with no definite natural boundaries. n Georgia the dividing line between the region occupied by this Brood XII and that of Brood VII is by no means well ascertained, as already on p. 250. In Tennessee the Cicadas were reported on the mountwest of Chattanooga, thus reaching the northeast corner of Ala. For this reason we are inclined to believe that the Cicadas re-

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re northern localities given in our previous records, viz, Fall River, Mass., , t., and Rochester, N. Y., were not confirmed by this year's investigation, e, therefore, been stricken off.

ported in northeastern Alabama, and more especially those of Saint Clair County (see p. 250), belong to the Brood XXII rather than to Brood VII.

The Western branch of the brood is a compact one of vast extent, and consisting of Indiana, the western half of Ohio, a number of counties in Kentucky along the Ohio River, and a narrow strip in Eastern Illinois adjacent to the Indiana line. This compact area extends northward into Michigan, but here the brood appears already to be broken up into several detached areas. From Indiana only a few counties have not been heard from; the Cicadas appear to be getting less numerous, and even scarce, in the northernmost counties and entirely absent in a few counties in the northwestern corner of the State.* In Ohio the brood extends east of the Scioto River at Columbus, but north of this place a number of counties in the western half of the State appear not to be occupied by it. A few detached localities are reported from the more central region of Illinois, and the southernmost localities in that State, where this brood comes in contact with Brood VII have already been referred to on p. 249. Finally a single, but very definite, report of the appearance of the Cicada in Southern Wisconsin has been received. This locality is very interesting, but widely separated from the main body.

SUMMARY OF DISTRIBUTION AND FUTURE APPEARANCE OF DIFFERENT BROODS.

Summing up the distribution of the Periodical Cicada (both 17 and 13 year races) within the United States, as now ascertained, it will be seen that the Cicada is known to occur in all the States east of the plains, excepting the northern portion of New England, northern Michigan, and the whole of Minnesota. It thus appears that this Cicada does not breed in those Northern States or portions thereof in which the woods are composed more or less exclusively of pine trees or other conifers. Rhode Island possesses no broods, so far as we know, but this may be for want of proper records, as several broods reach close to the borders of that State. Neither does the species occur in the peninsula of Florida, for reasons either of a climatic or geologic nature. Our knowledge of the western extent has greatly increased since 1868, and several broods can now be traced as far west as eastern Montana and Wyoming, central Colorado, and the extreme western parts of Texas, while less reliable evidence even indicates that the species may occur in western Montana along streams emptying into the Pacific Ocean. Unless this report be substantiated in future the distribution will not extend beyond the dividing range of the Rocky Mountains. The connection between the distribution of this insect and the botanical, geological, and topographical characteristics of the country forms a very interesting subject for consideration.

The earlier authors on the subject of distribution of the Cicada, including Prof. N. Potter, Dr. Harris, and Dr. Smith, arranged the chronology solely according to the years of the appearance of the Cicada. Dr. Fitch was the first to introduce the numbering of the different broods. However, from want of sufficient data, only a few of the broods actually in existence were known to him, and he confounded the broods of the seventeen-year and thirteen-year races of the insect. Thus, in order to avoid further confusion, we were obliged, in 1868, to renumber the broods, beginning with the brood that was to appear the year following that date, and numbering consecutively the broods as they were to appear.

*This is just the area occupied by Brood V (1871 and 1888).

ar in subsequent years. It is gratifying, after the lapse of seventeen ars, to find that twenty of the twenty-two broods thus tentatively ven by us have since been fully established by records. Brood III, shown by Bulletin 8, is evidently invalid, and we have stricken it it, while Brood X needs further confirmation of its validity; yet we ave deemed it best to retain the numbering of 1868, as that enumera-on marked an epoch in our exact knowledge of the various broods.

The following summaries may be made for convenience; the Roman rals indicating the number of the brood and the asterisk the 13-year ods.

During the next seventeen years there will occur broods of the Peri-dical Cicada somewhere or other in the United States, in the following ears:

1886. I.
1888. V and X*.
1889. VIII.
1891. IX.
1893. XI and XVI*.
1894. XII and XVIII*.
1895. II* and XIII.
1896. IV* and XIV.
1897. VI* and XV.
1898. VII* and XVII.
1899. XIX.
1900. XX.
1901. X* and XXI.
1902. XXII.

T every year except 1887, 1890, and 1892, will, during the next iteen years, be somewhere a Cicada year; and it will be noticed nere are thirteen *septendecim* and but eight *tredecim* broods, it fol-ows that when one of these last appear it will nearly always be in connection with one of the former.

It further appears that the number of distinct broods appearing in different years within the same geographical limits are as follows:

Alabama.—Four broods: years 1893 [XVI*], 1894 [XVIII*], 1896 [IV*], and 1902 [XXII or VII*?].

Arkansas.—Four broods; years 1891 [IX], 1894 [XVIII*], 1896 [XIV], and 1898 [VII*].

Colorado.—One brood; year 1891 [IX], and possibly another in 1893 [XI].

Connecticut.—Two broods; years 1886 [I] and 1894 [XII].

Delaware.—Two broods; years 1889 [VIII] and 1902 [XXII].

District of Columbia.—Two broods; years 1894 [XII] and 1902 [XXII].

Florida.—One brood; year 1896 [IV*].

Georgia.—Five broods; years 1893 [XVI*], 1894 [XVIII*], 1895 [II*], 1898 [VII*], and 1902 [XXII].

Illinois.—Seven broods; years 1888 [V], 1889 [VIII], 1893 [XI], 1894 [XVIII*], 1895 [XIII], 1898 [VII*], and 1902 [XXII].

Indian Territory.—Two broods; years 1894 [XVIII*] and 1896 [XIV].

Indiana.—Five broods; years 1888 [V], 1889 [VIII], 1893 [XI], 1894 [illegible], and 1902 [XXII].

–Three broods; years 1888 [V], 1895 [XIII], and 1896 [XIV].

s.—Two broods; years 1893 [XI] and 1896 [XIV].

y.—Five broods; years 1889 [VIII], 1894 [XVIII*], 1897 [XV], [illegible*], and 1902 [XXII], and possibly a sixth in 1893 [XI].

Louisiana.—Three broods; years 1894 [XVIII*], 1897 [VI
[VII*], and possibly a fourth in 1888 [X*].
Maryland.—Four broods; years 1889 [VIII], 1893 [XI], 189
and 1902 [XXII].
Massachusetts.—Three broods; years 1886 [I], 1889 [VIII],
[XX].
Michigan.—Three broods; years 1888 [V], 1894 [XII], and 1902
Mississippi.—Four broods; years 1894 [XVIII*], 1896 [IV
[VI*], and 1898 [VII*].
Missouri.—Four broods; years 1894 [XVIII*], 1895 [XIII], 189
and 1893 [VII*].
Montana and Wyoming.—One brood; year 1898 [XVII].
Nebraska.—Three broods; years 1891 [IX], 1895 [XIII], a
[XIV].
New Jersey.—Four broods; years 1889 [VIII], 1894 [XI
[XVII], and 1902 [XXII].
New York.—Six broods; years 1889 [VIII], 1894 [XII], 1898
1899 [XIX], 1900 [XX], and 1902 [XXII].
North Carolina.—Eight broods; years 1889 [VIII], 1893 [two
XI and XVI*], 1894 [two broods XII and XVIII*], 1898 [XVI
[XXI], and 1902 [XXII].
Ohio—Seven broods; years 1889 [VIII], 1895 [XIII], 1896
1897 [XV], 1898 [XVII], 1900 [XX], and 1902 [XXII].
Pennsylvania.—Eight broods; years 1888 [V], 1889 [VIII], 18
1897 [XV], 1898 [XVII], 1899 [XIX], 1900 [XX], and 1902 [X
South Carolina.—Two broods; years 1894 [XVIII*] and 1902
Tennessee.—Six broods; years 1889 [VIII], 1893 [XVI*], 1894 [
1896 [IV*], 1898 [VII*], and 1902 [XXII].
Texas.—Three broods; years 1888 [X*], 1894 [XVIII*], a
[XIV].
Virginia.—Five broods; years 1893 [XI], 1894 [two broods
XVIII*], 1901 [XXI], and 1902 [XXII].
West Virginia.—Five broods; years 1889 [VIII], 1897 [X
[XVII], 1901 [XXI], and 1902 [XXII].
Wisconsin.—Three broods; years 1888 [V], 1898 [XVII], a
[XXII].

THE INFLUENCE OF CLIMATE UPON THE RACES.

It has already been shown that the 17-year race is essentiall
ern and the 13-year race essentially Southern. But from the
at certain intermediate latitudes they either overlap or very cl
proximate each other, and the further fact that no races requi
intermediate periods for development are so far known, we
clude that the separation took place in the remote past and t
race is to-day but little affected by the character of the climate.
it may be questioned whether a hypogean insect which dwells
most part so deep in the ground as to be measurably beyond t
of the atmospheric changes of temperature will be very mate
luenced thereby. Yet there are several interesting scientific q
upon which light would be thrown by any obtained data
actual influence.

We have, for these reasons, had in mind for some time t
series of experiments by transferring the eggs of one of the *sep*
broods to the extreme Southern States in which the *tredec*
known to occur, and *vice versa*.

1881 we made some attempt by sending eggs of the *tredecim* brood II, obtained in Missouri, to a few of our Northern correspondents, but one exception the experiments were not made with sufficient care. B. Pickman Mann, then living at Cambridge, Mass., placed in our ls a record of some twigs which were sent to him. The eggs seemed e shriveled up so that he feared they might be abortive. But he ed some of them (four twigs) under a large apple tree behind his No. 19 Follen street; twelve sticks under a large oak tree about y directly south of the middle of an open space amid large tr on the path from Prof. C. E. Norton's house toward the Mu- n of Comparative Zoölogy; eight sticks under another large oak tree seventeen paces east-southeast of the last, and five sticks under larger oak trees about twenty-five paces directly east of the western er of Norton's woods.

he present year we have instituted a series of experiments which e tangible results, as we have taken precautions not only to see r the eggs really hatched at the different localities where they e placed, but to have the experiments recorded. We also place the of these experiments on record in this report, and it will be very resting in the future to observe whether or not the *tredecim* race require more than thirteen years for development at the Northern , or the *septendecim* race fewer than seventeen years at the South- points. We would therefore ask all those who may read this arti- and feel sufficient interest in the matter, and who may be living at time, to look for the appearance of Cicada at the points indicated ng the closing years of the present century and the first two years next, and to send to the Department the results of observations. following transfers were made with the kind assistance of the gen- ben mentioned:

BROOD VII (*Tredecim*).

ta.	Eggs received from—	Eggs sent to—
85.		
6	W. L. Peters, Senatobia, Miss	J. H. Comstock, Ithaca, N. Y.
1	P. H. Skipwith, Oxford, Miss	J. A. Lintner, Albany, N. Y.
13	J. G. Barlow, Cadet, Mo	H. Osborn, Ames, Iowa.
13	P. H. Skipwith, Oxford, Miss	Samuel Henshaw, Boston, Mass.
13	do	R. Thaxter, Kittery Point, Me.
13	do	A. S. Packard, Brunswick, Me.
17	W. L. Peters, Senatobia, Miss	J. H. Comstock, Ithaca, N. Y.
17	do	J. A. Lintner, Albany, N. Y.
17	do	Samuel Henshaw, Boston, Mass.
17	do	R. Thaxter, Kittery Point, Me.
17	do	A. S. Packard, Brunswick, Me.

BROOD XXII (*Septendecim*).

6	P. M. Webster, Lafayette, Ind	G. Noble, Savannah, Ga.
6	do	J. E. Willet, Macon, Ga.
11	E. Reeder, New Hope, Pa	D. L. Phares, Agricultural College, Miss.
11	P. M. Webster, Lafayette, Ind	E. A. Smith, Tuscaloosa, Ala.
15	E. W. Allis, Adrian, Mich	R. W. Jones, Columbus, Miss.
15	do	G. Noble, Savannah, Ga.
15	do	J. E. Willet, Macon, Ga.
15	do	B. H. Hardaway, Tuscaloosa, Ala.
15	do	D. L. Phares, Agricultural College, Miss.
21	do	Charles Mohr, Mobile, Ala.
21	do	Miss M. E. Murtfeldt, Kirkwood, Mo.
21	do	G. Noble, Savannah, Ga.
21	do	J. E. Willet, Macon, Ga.
21	do	D. L. Phares, Agricultural College, Miss
22	do	E. A. Smith, Tuscaloosa, Ala.
22	do	R. W. Jones, Columbus, Miss.
22	do	J. D. Wilkins, Selma, Ala.

The requests made of each of these correspondents were: To select a spot where the Cicada has not been seen the present year; to take an isolated tree (preferably in an orchard), which is not likely to be disturbed during the next seventeen (or thirteen) years, and to mark it plainly with a zinc label. The twigs were to be placed around the base of the tree, and watched at intervals until the eggs had hatched. We advised that a few twigs be retained in some vessel, so that hatching could be absolutely proved, and that a record be made of the fact in the case and published in the local paper or elsewhere. We also strongly urged the importance of exactness in this record, as the success of the experiment would largely depend upon such exactness.

The eggs sent to Prof. J. H. Comstock, at Ithaca, N. Y., hatched well and the twigs were placed July 10, 1885, "under the large hickory tree which stands midway in the row of elms on the north side of the avenue leading from Morrill Hall to the residence of President White. * * It is the only hickory tree in the row. It is the ninth tree east of the University avenue and the ninth tree west of the President's avenue. Specimens were placed in the permanent collection of Cornell University at Ithaca under the number 181, sub. 2, with conspicuous label "Read in 1898," and a folded label with details.

Those sent to Dr. J. A. Lintner, at Albany, N. Y., were placed in the orchard of Mr. Erastus Corning, at Kenwood. "The tree beneath which the eggs were planted (they were hatching when the twigs were placed about the base of the tree and tied to its branches) was marked with a zinc label, bearing this inscription: 'Thirteen-year brood Cicada (Riley's brood No. VII); eggs from Oxford, Miss., planted June 4, 1885.' Additional eggs from a second sending were placed under same tree on July 21, and also some in a wood adjoining, a few rods to the south, to serve as a food supply in the event of the death or destruction of the orchard." In the planting Dr. Lintner was assisted by Mr. William Grey, gardener of Mr. Erastus Corning, who was requested to communicate to others on the farm the exact location of the tree.

The twigs sent to Prof. Herbert Osborn, at Ames, Iowa, were deposited by him under two trees on the college farm, which may be described as follows: First, an apple tree standing directly east from the house occupied by Dr. B. D. Halstead and north of the house occupied by Professor Osborn, the farthest to the south of the group of apple trees standing in that part of the grounds; second, an elm tree standing 25 yards directly south from the house in which Professor Osborn is living. This house stands a little south of midway between the "Farm House" and "South Hall," on the east road between those two buildings, or the farthest from the main college building in an E.S. direction. The apple tree is S.SW. from the farm-house and E.S. from the main college building. On each of the trees is hung a zinc label with the inscription: "Twigs from Cadet, Mo., containing eggs thirteen-year Cicada, were placed under this tree July 21, 1885."

The eggs sent to Mr. Samuel Henshaw, at Boston, Mass., were placed about two apple trees in an orchard owned by Prof. Alpheus Hyatt, Annisquam (part of Gloucester), Essex County, Massachusetts. The trees in question are the two opposite the southwest corner of the house.

The three lots of eggs sent to Mr. George Noble, of Savannah, were received by him in good condition, and hatched perfectly. They were placed under certain cherry trees, each marked with a zinc label, on the farm known as "Keiser's," 1½ miles southeast from the City Exchange.

The twigs sent to Prof. J. E. Willet, at Macon, Ga., were deposited

l Park, at Macon, as follows: "The twigs from Indiana were the base of three trees; first, a small elm just within the , about 100 yards eastward of the turn of the track the main entrance; second, a fine hickory on the bluff of the about opposite the middle of the track, and third, a sweet gum bluff, about 100 feet southeast of the hickory. These three trees h a zinc label with the legend, 'XVII-year Cicada, Indiana, -02–1902.' The twigs from Michigan were deposited at the base sweet gum at the north end of the Editor's Home. The zinc label on ree bears the legend, 'XVII-year Cicada, Mich., 1885–'98–1902.'"

. D. L. Phares, of Agricultural College, Oktibbeha County, Mis-pi, deposited the first twigs sent to him on the ground under the of a hickory tree standing 6 feet, a little south of east, from the bot- of the steps of the front porch of his house at the Agricultural and anical College. The second lot which he received he deposited a hickory tree standing 16 feet west of his parlor. There are no : nickory trees near the two described.

of. Eugene A. Smith, of the University of Alabama, at Tuscaloosa, placed the twigs sent him about the roots of three isolated oaks *phellos* and *Q. aquatica*), situated not far from the center of the t quarter of the college campus. They are the only trees in this t quarter, except along the fence, and there will be no difficulty ifying them.

e eggs sent to Mr. John D. Wilkins, at Selma, Ala., were deposited l at the foot of a water oak (*Q. aquatica*), which may be reached icing at the northeast corner of Second and Union streets, at the fence corner on the sidewalk, and measuring east along u street for 85 feet; thence north at right angles 64 feet to the

ss M. E. Murtfeldt, at Kirkwood, Mo., placed the twigs sent to her r two young apple trees standing somewhat apart in the northeast of Mr. C. W. Murtfeldt's orchard at Kirkwood, and too close to ivision fences to admit of the ground on which they stand being ed.

. Charles Mohr, of Mobile, Ala., writes that the experiment was, him, a probable failure, as nearly or quite all of the eggs had hatched e being placed, owing to his absence from home when received. :wigs were placed, however, under a pecan tree in Dr. Mohr's yard obile, and there is a possibility that a few larvæ entered the ground hat some Cicadas will be observed in 1898 or 1902.

THE PERIODICAL CICADA IN 1886.

the above consideration of the two broods of the year 1885 we l add a few words concerning the brood which is to appear in 1886. is our *septendecim* Brood I, and the localities in which it has been ved at several intervals of seventeen years, up to 1869, are the ies of Franklin, Bristol, and Hampshire, in Massachusetts, and Connecticut River Valley, in Connecticut, near to the Massachu- line. No other well-established localities for this brood are known, t may possibly occur at other places either near by or even in other of the country.* We would ask the reader to assist us in our to correctly determine the geographical limits of this brood us reports of the appearance of the Cicada in 1886.

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*wo concurrent reports from Trimble and Oldham Counties, Kentucky, we ct that Brood I occurs there.

Another reason for alluding here to this Brood I is its relation to Brood XXII. In mapping the localities ascertained for Brood I it is at once apparent that they form an appendix to, or a continua n a northeasterly direction, of the territory occupied by the Eastern or of Brood XXII, which always precedes Brood I by one year. From relationship as regards time and distribution, the inference is t that the small Brood I was originally derived as an offshoot fr large Brood XXII.

THE LEATHER-BEETLE OR TOOTHED DERMESTES.

(*Dermestes vulpinus*, Fabr.)

Order COLEOPTERA; Family DERMESTIDÆ.

[Plate VI; Fig. 2.]

INJURY TO BOOTS AND SHOES.

This insect has the past season come under our notice for t time as a destroyer of manufactured boots and shoes. Our firs mation of the damage done in this way was the receipt of a September from Mr. John Mueller, editor of the *Leather G* , Saint Louis, who stated that a number of the wholesale boot and s houses of Saint Louis had suffered great loss from the beetles durin the summer. We immediately instructed Miss Murtfeldt to investi the matter, and subsequently (in November) we made a visit to Louis, during which we looked into the subject.

During the last week in October, Mr. F. Einstein, of A. Ei n Sons, of Savannah, Ga., called on us in Washington on account a suit in which his firm had engaged against the Boston and Savan Steamship Company, by reason of damage done to boots by this b while being shipped, as he alleged, from Savannah to Boston. To u case we shall refer later.

The history of the Saint Louis appearance is briefly as follows: T insect was first noticed in the establishment of Mr. John Meier, wh sale manufacturer of boots and shoes, at 416 and 418 Christy av in the spring of 1884, when a lot of boots and shoes which had been to some Southern town were returned condemned as "wormy." Th led to an examination of the stock in store, and the proprietor found, t his great astonishment, that there was justice in the complaints of t customer, and that several boxes of heavy boots and shoes which been packed for some time were literally swarming with the i all stages of development. This was the first time that he k known of the existence of such a pest.

About the same time the insects were found in numerous houses throughout the city and invaded the manufactories. In t summer of 1885, public attention was called to the pest by vario and exaggerated accounts of a "grub" which worked u m soles of shoes, reducing them to mere shells which crushed into f ments when subjected to the pressure of the foot in wearing. T *Globe-Democrat* and other dailies, as well as the *Leather G* , tained articles descriptive of the damage, but none sugges tory remedies.

Neither Mr. Meier nor other dealers were able to trace the introdu

this insect from any particular warehouse or tannery, but learned nners that it was quite common in old hides, and was by them "the dry hide-worm."

e warehouses and manufactories the insect still retained its par- for undressed leathers, and an examination at once shows that the nd heels of boots and shoes are more liable to injury than the It seems probable that the comparative immunity of the uppers o the oily dressing used in the finishing processes. They do not, r, entirely escape, for occasionally they are found bored by the r roughened and eroded by the beetle.

ECORDED POINTS IN ITS HABITS AND NATURAL HISTORY.

its other congeners this species has been known in the past to on skins and hides, and to be particularly found about rendering We have found it in association with *D. marmoratus* under bones in Kansas, have reared it from dry entomological speci- Saint Louis, and have received it through the State Depart- very injurious to hams in Arizona.

wood (Introduction, &c., vol. i, pp. 157, 158) quotes Kirby as ty for the statement that the larvæ were found in some speci- f "flexible asbestos called Amianth, and which they had per- in various directions, undergoing their transformations therein." remarks: "That these holes were not made merely for the pur- the insect becoming a pupa therein is evident, since they are rticular in selecting a spot for this purpose, not only becom- in the excuviæ of the animal they have devoured, but even neir own excrement. Moreover the holes were of various sizes." states that the species was at one time so injurious in the large rehouses in London that £2,000 was offered as a reward for an remedy, but without any being discovered; also as being quite to cork, an entire cargo of that article having been destroyed ; feeding upon the cork as well as upon the timbers of the

Entomologist's Monthly Magazine (London), for December, 1884 p. 161), Mr. James J. Walker gives an account of the exceptional nce of the species around the bone-boiling works at Queenborough and, and the difficulty which the workmen found in keeping the out of their houses, to the woodwork of which they did much . A thick oak plank was shown him, about 12 feet long by 1 le, reduced to a perfect honeycomb by the ravages of the *Der-* arvæ. They had bored into the solid wood to pupate. This is recent reference to the wood-boring habit of the larva which n so conspicuous in the injury which it has done to the boot and de.

ggs (Plate VI, Fig. 2 *a*) have not been noticed on the shoes, but lot of living beetles obtained on November 12 we secured eggs on 16. The beetles, together with a number of larvæ, were ar with some sausage and some bits of blotting-paper. The urust in between the layers of the blotting-paper, the beetles y eferring a tight crevice. The eggs are pure white, highly ly cylindrical, slightly larger at one end than at the other, ery licate. They are 2^{mm} long by 0.5^{mm} wide at the thickest are encircled by about twenty shallow transverse impressed

not prepared to say how many eggs are usually deposited by

a single female. One female which was isolated with a male was ol served to lay seventeen eggs before she died, and another, twenty-th eggs; but this, of course, cannot be taken as the full number. hatching the eggs swell somewhat at the larger end and the fo insect is plainly seen through the transparent shell. The eggs from four to seven days.

The newly-hatched larvæ are very pale, almost white in color, furnished with long hairs at birth, and are quite active. In few hou they acquire the normal brownish-gray color and bury then l their food. They crawl with considerable rapidity, mounting i surfaces with ease, apparently excreting from the anus an a substance which prevents them from falling. In the breeding s, wi plenty of food and a constant temperature of from 68° to 7o~ F., t larvæ cast their first skin in from four to nine days, the great majori molting at seven days. Under the same conditions the second skin cast at from four to seven days, the majority molting at six days: third skin at from three to six days, the majority molting at five and the fourth skin at from three to six days, the majority molt five days; the fifth skin at from five to seven days, and the sixt at six days. There are thus seven larval stages.

The fully-grown larva now prepares for pupation, by forming a cavi in the substance it was feeding upon, or in any other suita e te near by. In the cavity or cell thus formed we find the moti in a curved position, loosely covered with bitten-off particles or the rounding material. Resting for six days in this position, the last larv skin is cast and the pupa state (Pl. VI., Fig. *h*) assumed. Unde favorable, *i. e.*, winter, conditions (November and December), the peri from hatching to the assumption of the pupa state has been as bri as forty-five days, and the pupa state has lasted fourteen days.

From our experience with other species of this family, *Dermestida*, is plain that no general statement as to the duration of the larva sta can be made. Under the influence of a very warm temperature. that of Saint Louis or Savannah in midsummer, and with plenty of ishing food, we are convinced that it may become only a matter of two three weeks; while, on the other hand, with an insufficient supply of or a lower temperature, it may be extended for several years, as we kn from our experience with other species of *Dermestes*, and with species the allied genera, *Anthrenus*, *Trogoderma*, *Attagenus* and *Perimegat*

The work of the larvæ, both young and full-grown, in boots and s consists in boring round smooth channels in every direction thr the leather, preferring, as previously stated, the soles and heels. A vorite place for entering the shoe is in the angle between the heel or in the crevice between the upper and the sole, a crack or kind seeming to be necessary to enable them to get sufficient pur commence boring.

The full-grown larva (Plate VI, Fig. 2 *b*, *c*) is a thick, hairy, grub about 13^{mm} long and one-fourth as broad. It tapers somew from the thorax to the anal end, which is bluntly pointed and a with a pair of thorn-like projections. There is a pale longitudinal down the back, and the six true legs are long and strong and of dish-brown color. With these it crawls rapidly with a quick, d motion, dragging the hind body on the surface over which it is The six posterior joints are each armed above with a transve row retrorse thorns, the purpose of which is difficult to surmise, unl t is

* See *Am. Naturalist*, May, 1883, p. 457.

, when the last skin is cast, the soft pupa in its cell. This be- ıre probable as the thorns occur only on the last larval skin, ı ıound previous to the last stage, and as the last larval skin s ı ı ıal end first, into the opening to the burrow in which the ıormed.

ı pupa is sometimes found in the larval burrow, but more often the ıll-grown larva leaves the leather and seeks for a crack in the box or loor, often burrowing for its length into the solid wood. In the warehouses, where the goods are boxed up in soft wood, the boards are often riddled by these burrows made by larvæ seeking for safe places for pupation. This instinct of self-preservation is necessary, as the larvæ have a fondness for the soft, helpless pupæ of their own species, even when other and more natural food abounds. The pupa is white in color until just before the adult insect issues, when it becomes darker.

The duration of the pupa state in summer is unquestionably shorter than we observed it in winter. The closely related *Dermestes lardarius*, according to Dr. Horn,* remains in the pupa state for a period varying "from three or four days to a week, or even more, depending principally upon the warmth of the locality." It is probable that about the same statement can be made of the species under consideration for the summer months.

The principal occupation of the adult beetle is the propagation of the species, yet it also is a leather destroyer, gnawing and scoring the surface of the boot or shoe, but not burrowing bodily into its substance. The beetles (Plate VI, Fig. 2 *x*) are sluggish in cold weather and at night, becoming aroused and active by light and warmth, flying by preference in sunshine, and at other times confining themselves to the use of their legs, with which they run very rapidly. Watched in the vivarium, they appear to have a delicate sense of hearing, as on the approach of another beetle they will stretch their antennæ forward, at the same time raising the front part of the body as high as their short legs will allow them. They feign death with great success when they cannot escape capture in any other way, and will suffer themselves to be handled for some time without signs of life.

The beetle (Pl. VI, Fig. 2 *k*), varies from 8^{mm} to 12^{mm} in length. It presents superiorly a rather uniform, brownish or grayish-black appearance, the general color varying somewhat according to maturity. In the more perfect specimens the dorsal surface is clothed with very short, pale, yellowish, and rufous pubescence. The head and a broad band on each side of the thorax are more thickly covered with denser and longer silver-white hairs, and this last character, together with a minute spine at the inner tip of each elytron, are the most superficial distinguishing characters of the species. The ventral surface is closely covered with silvery-white pubescence, as with most of the species of this genus, a ies of lateral spots appearing dark by the absence of this pubes- e. These are so distinct in *vulpinus* that the species was described *culatus* by De Geer. The anal segment has, in addition, a large smooth space, and the penultimate segment, in the male, has a smooth space in which is situated one or more minute spinous s.

LITIGATION GROWING OUT OF ITS INJURIES.

following statements in reference to the causes of the suit ıt by Einstein's Sons are upon Mr. F. Einstein's authority, and them as such, and without indorsement, because we have not other side.

* Proc. Ent. Soc., Phila., i (1861–1863), p. 28.

In July, 1884, 86 cases of calf boots were shipped by the C wealth Boot and Shoe Company, of Boston, by one of the st ner the Boston and Savannah Steamship Company, to A. Einstein's Sons, of Savannah. They were held at the Einstein's establishment, which is exclusively a boot and shoe store, for four weeks, and were returned to Boston in August, as it was decided that they did not come up to sample. The boots were examined several times while in Savannah, and t ast time on the day before shipment, but no insects were noticed evidence of their work; nor had the beetle been seen or heard of by one in the Einstein's establishment. On their arrival in Boston, a journey of five days (and they may have remained upon the wh of the company at Savannah a day or more before shipment), the boots were examined by the president and treasurer of the Commonwealth Company, and were then for the first time noticed to be slightly dam aged by insects, of which no one knew the nature. On arbitration it was decided that they did come up to sample and they were reshipped to the Einsteins, the steamship company giving a clean bill of lading, notwithstanding the fact that the invoice stated "damaged by bugs."

The goods arrived in Savannah the second time during the fi w in September, and remained on the wharf four days. Before bei re moved they were examined by Mr. F. Einstein and his stock u s the wharf clerk, and were found to be swarming with adult beetles full-grown larvæ. In burrows in the leather were cast-off larval s of large size, and in burrows in the pine wood of the boxes were pu They were then removed to the store, and the adult beetles come through the wood of the boxes by the hundreds. They were shown u H. Meyer Bros., hide dealers, who pronounced them to be genu "Hide Bugs." A paste, known as "Peruvian Bug Paste," was appli to the boxes, which were then removed to a warehouse. They wer examined again two days later and were still found to be "full of bu

They were then thoroughly treated with 20 pounds of pyreth bought at a drug store, but the effect of the application was not ticed, as, acting on legal advice, the Einsteins immediately shipped boots to a firm of correspondents in Boston, instructing them to them overhauled, repacked, and reboxed and sold at auction as dam aged goods, making the best disposition of them possible. This done (the steamship company on this shipping refusing to give a bill of lading, but entering the goods as "damaged by hide bugs"), by the sale the Einsteins sustained a loss of $950, including all expe excepting freight. They then brought suit against the steamship c pany for damages to this amount, claiming that the goods be originally infested by the bugs while in the company's charge. claim that the company carries on almost every trip large quanti hides to the North; that many of these hides are insufficiently poiso and must be infested by "hide bugs"; that in midsummer, with a carr ing trade of this nature, it would be almost impossible to keep the wharv and vessels free from these insects on account of their tenacity of and tendency to work into cracks and crannies and keep then hidden; that their own store is and always has been uninfested; th the insect is not a leather pest in Boston, and that, therefore, the les must have made their way into the boxes of boots either while ere upon the company's wharves in Savannah, or while they were he steamer upon their first return to Boston.

At the time of the present writing the case has not been d From our knowledge of the insect and from what facts in the w

e to learn, as well as from the history and habits of the
following conclusions seem justifiable:
careful and thorough examination should prove the con-
esumption would be that the insect occurs in the Boston
and warehouses, as no reasons appear why it should not.
iginal infection may have taken place either in Boston before
it, upon the original trip from Boston to Savannah, upon the
or while the goods were stored in the Einstein establishment.
e exact nature of the damage observed upon the first return of
ls in Boston is important, as if there was evidence of full-grown
of pupæ, the infection would, presumably, not have taken place
irst return trip, but must have been prior, notwithstanding the
d freedom of the goods when first returned.
e first infection by eggs and young larvæ is not easily detected,
eriod of at least three weeks must be allowed for the develop-
numbers of full-grown larvæ, or beetles from within the cases.
e leather or boot-feeding habit is exceptional, and our experi-
t Washington indicate that the larva forsakes leather for most
nimal substances. The inference would, therefore, be that the
ould not readily, either as larva or beetle, forsake hides to en-
s of shoes, *i. e.*, that the damage would be of slow development
han sudden.

REMEDIES.

this insect has already made an entrance into cases of boots
es it will not be a difficult matter to destroy it by a proper use
phide of carbon. Of course it would be preferable to thor-
overhaul the contents of each box and to treat the boots found
ifested, with benzine or some other efficacious insecticide, but
his cannot be done without too great expense it will probably
o open each case and place an open saucer of the bisulphide on
he contents. The liquid will volatilize and the vapor will sink
rough the mass if the box be tight, and will kill the insects in
irrows.
ventive, however, will be of greater importance than a remedy
case, and of prime importance in the more Southern manufac-
in such warehouses as store both leather or dry hides and
In many manufactories must occur such breeding places as the
ch was found in Mr. Meier's establishment in Saint Louis. All
the late spring and summer the clippings and scraps from the
ops were gathered up day after day and dumped in a conven-
ce in the cellar, there to await the starting of the furnace fires
utumn. By the time it was convenient to burn it this mass of
eather was swarming with insects and large numbers of the
oving beetles inevitably escaped and lived to perpetuate their
all parts of the building.
breeding places without doubt exist in almost every manu-
d should be looked for, their living contents destroyed by
d then the whole pile should be burned. In Southern
ts, where this insect is known to exist, there will be no
ex t in great care and excessive cleanliness. Scrap leather
not be allowed to accumulate in any part of the building, and
ght in should be examined and poisoned on arrival. Fre-
nations of stock on hand should be made if there is any
pect the presence of the beetle. With such precautions

the damage of the Leather Beetle to boots and shoes can be avoided in the manufactory.

In the case of transportation of made-up leather goods by transportation companies which also carry hides, it devolves upon such companies to exercise the same degree of care and cleanliness, as they are otherwise liable to lay themselves open to damages payable to the owners of the more expensive goods.

DESCRIPTIVE.

We have already indicated the character of the egg and the distinguishing characters of the mature beetle. The pupa (Pl. VI, Fig. *h*) will be found to possess no characters of value to distinguish it from that of allied species. It is very difficult also to separate the larva from that of other closely-related species; nor have the species of the genus been sufficiently well studied or described in the adolescent states to enable us to point out what differences there may exist. As a beginning in this direction, and because no detailed description of this larva has been published, we append one:

DERMESTES VULPINUS.—*Mature larva.*—Average length, 14^{mm}; greatest diameter, 3^{mm}. Subcylindrical, tapering both ways, but more suddenly posteriorly. Color above at the interstices luteous-brown, the horny plates polished, deep chestnut-brown; a medio-dorsal, rather broad line. Ventrally pale yellowish-white, becoming posteriorly, where, from joint 6, the dark color of the superior surface includes the spiracles and then extends more and more beneath until from joint 10 to the pseudopod the whole inferior surface is more or less brown. Legs yellowish-brown, with dark-brown chitinous pieces around exterior of base and on the trochanters. Prothoracic spiracles on a lateral fold between joints 1 and 2, and four times as large as the others. First and second abdominal spiracles easily detected by virtue of their being upon the white ventral ground, the others obscured by being within the brown posterior shade. Head above dark chestnut-brown, opaque, roughly and irregularly punctate, with numerous small tubercles that give rise to hairs. Between the tennæ, and about equidistant from them, are two wart-like protuberances. Antennæ (Pl. VI, Fig. 2 *e*) light brown, except the mandibles and the rather prominent ocelli, which are black; a space around the ocelli, connecting with an anterior spot with the medio-dorsal line, is light brown; ocelli, 6; antennæ short, 3-jointed, second joint longest; mandibles robust, with three sharp teeth at their tips, which are strengthened by thick, chitinous ribs; maxillæ (Fig. 2, *f*) short, with two terminal lobes, of which the interior one is a corneous hook; maxillary palpi very short, 2-jointed; labium (Fig. 2, *g*) quadrate, corneous, with short, 3-jointed palpi. Joint 1 of body is as long as 2 and 3, and it is also distinguished by lacking the elevated ridges; its whole surface is dotted with small piliferous tubercles, which are much more prominent near the lateral and the anterior margins. All joints possess a straight row of tubercles along the posterior margin (Pl. VI, Fig. 2 *d*); the hairs arising from them are very long and directed posteriorly; also six elevated, transverse-diagonal ridges, from which arise from six to eight coarse, bristle-like hairs, which are movable. Joints 7 to 12, inclusive, differ from the others by each possessing in addition at their anterior margin a sculpture of teeth-like elevations, varying in number from fifteen to seventeen, and pointing backwards. Besides the hairs already mentioned, which are dark-brown on the upper surface, there are many much finer hairs, which arise from smaller tubercles scattered all over the space between definitely arranged ridges. The eleventh joint is further distinguished by possession of two stout and pointed horns, directed backwards and curved upwards at their tips. The very small terminal subjoint, clothed with but a few long hairs, is retractile, and is used with its extensible sticky anus as a pseudopod. All the early larval forms are very similar. When born the larva is almost pure white, with light brown hairs; this color rapidly changes within a few hours to the normal dark-brown with paler, medio-dorsal stripe.

The differences between the young and adult larvæ may be formulated by stating that the more immature larvæ are somewhat paler, are clothed with comparatively longer and finer hairs, and principally so on the posterior joints, and lack the peculiar sculpture of teeth-like projections upon the posterior joints 7 to 12. This sculpture first appears with the sixth molt or in the last larval stage.

THE GARDEN WEB-WORM.

(*Eurycreon rantalis*, Guen.)

Order LEPIDOPTERA; Family PYRALIDÆ.

[Plate VI; Fig. 3.]

'erha the most marked insect outbreak of the year has been the ıce of *Euycreon rantalis* over a large area in the five States of missouri, Kansas, Nebraska, and Arkansas, and also in the In- rritory. It has attracted a great deal of attention, and the dam- uone has been very great. The principal crop to suffer was corn, replanting was necessitated in many instances. The general corn p for the year, as statistics show, has been larger than ever before, the having been widely extended; but the yield per acre in the States was reduced, owing, largely, to the operations of this insect.

ycreon rantalis is quite a wide-spread species, occurring all over united States. It has been captured in South America, and the description of the species was from a specimen from Monte- It is also a very variable species, and has been variously de- under the names of *crinisalis* by Walker,* of *communis* by and of *occidentalis* by Packard.‡ It is referred to the genus *ula* by Guenée, and *Scopula* by Walker, but properly belongs to ıerer's more restricted genus *Eurycreon*.

moth (Plate VI, Fig. 3) has an average expanse of 18mm. The al color is either orange or reddish-yellow inclining to buff, or more nly a lighter or darker shade of gray, having, in certain lights, a copperish or greenish reflection very similar to that on the well- n Cotton Worm Moth (*Aletia xylina*). The characteristic markings, nown in the figure, are the darker reniform and orbicular spots h a ler shade between them; two irregular transverse pale lines, y relieved by darker shade, most intense posteriorly on the an- u and basally or interiorly on the posterior line. The terminal may be either paler or darker than the ground color. The mark- very variable, however, dark specimens (*rantalis*) having them wen defined, paler specimens (*communis*) less so, while in others *alis* [*crinitalis*, Led.]) the anterior line and inner portion of pos- li may be lacking. *Dasconalis*, Walker, is probably but a dark and should be added to the synonymy.

ıarva, which seems to have been unknown prior to 1873, when we manuscript notes and descriptions of it, is also somewhat varia- ın color, being either pale or dark-yellow or even greenish-yellow. ked with rather distinct jet-black piliferous spots, as illustrated ıgure. In the better-marked specimens there is a quite distinct ıouble line along the middle of the back and a single one at the le. The piliferous spots are also more or less distinctly re- ıy a pale border.

pupa (Pl. VI, Fig. 3 *d*) is of the normal brown color and charac- l by the tip of the body having two prominences, each furnished ee stout short spines.

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*List of Lep. Ins. in Brit. Mus., part xviii, Pyralides, p. 798 (1859).
†*Canadian Entomologist*, vol. viii, p. 99, May, 1876.
‡Ann. Lyc. Nat. Hist., 1873, p. 261.

FORMER INJURIES.

This species has not before been prominently treated of as a wide spread injurious insect, though it has done a certain amount of damag in times past. In 1873, we observed it feeding in great numbers fo miles along the Neosho Valley, in Southeastern Kansas, skeletonizin the leaves of Helianthus, Ambrosia, Amaranthus, beets, potatoes, a other garden plants.

In June and July, 1880, it again appeared in injurious numb parts of Kansas, and Prof. F. H. Snow wrote a short account of it the issue of the *Lawrence* (Kansas) *Daily Journal*, of July 28, printed in *Psyche*, III, p. 127), in which he gave a short descrip the larva, and stated that it fed on sweet potato, alfalfa, beets, Pig-weed (*Amarantus*), and Purslane (*Portulaca*).

According to a correspondent of the Department in Reno Co Kansas, it was extremely injurious in his locality in 1880 to sorg corn, millet, and garden vegetables.

After its occurrence in 1880, Prof. E. A. Popenoe, of the Kansas Sta University, published an article in the Second Quarterly Report 1880 of the Kansas State Board of Agriculture, which gives the published account of the insect up to that time, and in which the pupa, and imago are described with sufficient care to obviate fur detailed description here. The cremastral characters of the pupa (s VI, Fig. 3, *e*) which we have indicated, are characteristic, and any full description of the larva should be comparative, and especially other allied larvæ like that of *Botys maculenta*, G. and R., which closely resembles it.

June 27, 1881, we received two larvæ of *rantalis* from Mr. W. C. L of Malden, Mo., with the statement that the species did great dam to Cotton, and the same month it was received from Lamar, Mo., damaging corn and garden crops.

One of our correspondents, Mr. W. G. Robinson, or Rosston, C County, Texas, more observant than others, has noticed the same for the last ten years in his county, where he states that it ap yearly to a limited extent, feeding principally on the "Kerle (*Amarantus*), but that 1885 was the first season in which he hau it to do any damage to the cotton crop.

LOCALITIES OF DAMAGE IN 1885.

The first report of damage done by this insect the present year received June 22, from J. M. Altoffen, of Independence, Montgome County, Kansas, and from that time until late in July we were in co stant receipt of letters concerning it. Specimens were received fro the following localities: *Texas:* Cook, Erath, Denton and Hopkins C ties; *Arkansas:* Crawford County; *Missouri:* Jasper and Vernon C ties; *Indian Territory:* Colbert and Econtuchka, Seminole Nation, a Vinita, Cherokee Nation; *Nebraska:* Lancaster County; *Kansas:* Co ley, Montgomery, Coffey, Labette, Cherokee, Crawford, and C Counties. Prof. F. H. Snow, in the report of the Kansas State Boa of Agriculture for the month ending June 30, 1885, states that han thirty-five counties reported more or less damage from this Those reporting the heaviest damage were all situated in the eastern quarter of the State, and were, excluding the seven al mentioned, Allen, Bourbon, Chautauqua, Elk, Greenwood, Harper, [illegible] Summer, Wilson, and Woodson, a

teen in all. The remaining fifteen, which reported slight damage, were Anderson, Barber, Butler, Chase, Ellis, Finney, Ford, Lyon, Marion, Pawnee, Pratt, Rice, Saline, Stafford, and Wyandotte.

FOOD-PLANTS.

There is no question but that the preferred food of this species is the foliage of plants of the genus *Amarantus*, called in different parts of the country Amaranth, Pig-weed, and Careless weed (corrupted into "Kerless weed" or "Karless weed"). This was very noticeable in our observations of 1873, and its next preference seemed to be Purslane. Professor Snow also mentions Lamb's Quarter (also called "Pig-weed" *Chenopodium*), as a favorite food-plant. Prof. C. E. Bessey, writing from Lincoln, Nebr., August 11, mentioned an unusual abundance of these larvæ upon *Amarantus retroflexus* and *A. blitoides*. Another correspondent mentions finding them the present year upon the common Cocklebur (*Xanthium strumarium*), but this was probably due to their excessive abundance and want of proper food. This also is probably the case with the common Burdock (*Rumex*), which is mentioned by another correspondent. Professor Popenoe (*loc. cit.*) mentions, among the weeds injured, *Amarantus alba*, *Chenopodium album*, *Ambrosia trifida*, *Apocynum cannabinum*, and *Grindelia squarrosa*. He also mentions the fact that they injured a bed of scarlet verbenas.

The cultivated plants injured during the year, according to our own correspondents, are as follows: Corn, cotton, cabbage, cucumber, melon, squash, pumpkin, sweet potato, Irish potato, egg-plant, tomato, beets, bean, pea, red clover, alsike, alfalfa, orchard-grass, timothy, meadow oat grass, millet, and apple-tree leaves.

Thus it appears to be able to feed on almost any plant commonly grown in truck gardens, and upon a variety of forage plants. No one has mentioned, in fact, any plant upon which it will *not* feed. Professor Snow, in the article just cited, gives the following food-plants additional to the above: Flax, tobacco, sugar-cane, castor beans, lettuce, and onions.

The species has been very generally referred to as the "Web-worm," but as this is a very comprehensive term, we have called it the "Garden Web-worm," as a means of distinguishing it from the many other Web-worms, most of which, however, occur on shrubs and trees.

HABITS AND NATURAL HISTORY.

The full natural history of the species has not yet been made out. The eggs have not been described, the method of hibernation is not positively known, and the number of annual generations has not been carefully determined. Some of these gaps we would have endeavored to fill up the present year but that we were much away from the office.

Number of annual Generations.—From our own observations and from what we have been able to learn from our correspondents, the first
d of moths is noticed from May 1 to May 7 in Texas, from May 20
y 25 in Missouri, and from May 20 to June 6 in Kansas. If, as is
ther likely, the insect hibernates as a moth, then this May brood
e considered as a *second* brood of moths, and as the adult off-
of the hibernating individuals. The larvæ of the May brood of
noticeable (*i. e.*, full grown in numbers) from May 25 to June
, from June 10 to June 18 in Missouri, and from June 7 to
ansas. Another brood of moths (the adults of the destruct-

ive brood of worms) was noticed June 25 in Texas, July 10 in Missouri, and July 1 in Kansas. The offspring of this last (third) brood of moths were nowhere noticed as injurious.

The worms were reported in small numbers July 15 from Kansas. August 11 full-grown larvæ were received from Nebraska, from which State they had not before been reported, and it is possible that these individuals were the offspring of a fourth brood of moths. More probably, however, circumstances being apparently less favorable to their rapid increase, they were the retarded third brood of worms.

The statements which we have just made have only a general bearing, and the same confusion of generations was noticed, in all localities where the insect occurred abundantly, which is always noticeable in the undue development of any species. Larvæ of all sizes were working together in Texas, and what we take to be the third brood of moths was flying before many of the second brood of larvæ had ceased to work. From the facts at hand it may be safely concluded that there are normally four or five annual generations, and possibly one or two more under favoring circumstances. Dr. J. J. Kackley, of Chetopah, in writing to Professor Snow, says: " * * * But few of the webs contain more than one inhabitant. I, therefore, do not think they are gregarious in their habits, but the force of numbers drives them to limited space. The wheat and oats appear to be exempt from their ravages, and this may be accounted for in consequence of the blades at this time being well lifted from the ground, as they are rarely found feeding upon the leaves of plants more than 12 or 15 inches from the root. When the top of the corn-plant is above this height the central portion escapes, and the worms confine their mischief to the lower blades of the stalk. These lose their green luster and wither, remaining sickly and pale; but at the same time the head is pushing forward in vigorous growth, and does not succumb to death like the younger plants of smaller stature. * * *"

Professor Popenoe gives the following account in the 1880 article already cited:

"The following points in its history are the partial result of my study of this insect. Although I made careful search for the egg, I failed to discover it *in situ*, but it is without doubt deposited on the lower side of a leaf, or low down among the bases of a cluster of leaves, as newly-hatched larvæ are found in both these situations, from which they soon wander to other parts of the plant. As soon as it [the larva] begins to move about, it begins to spin the web, and this is increased in extent as the movements of the larva are extended. It is very active in all stages of growth as a larva, and springs aside quickly when touched, sometimes throwing itself into a coil, but more often running rapidly away. At least in early life, the larva, when thrown off a leaf, will hang by a thread of silk. In case a single leaf is of sufficient size, as in the sweet potato, the well-grown larva is generally found on the upper side, in a shelter formed by drawing partly together the edge of the leaf by the silk of its web. In this shelter it is usually found at rest during the day, hanging by its feet, back downward, to the lower surface of the web. In other plants, several leaves may be drawn together for a place of concealment. If, indeed, the larvæ are not partially gregarious, they are at least not disturbed by proximity to each other, as several may be found, at times, in a common web, although I believe this is exceptional. As they are forced to move to new parts of the plant for fresh food, their webs are extended, until finally the entire plant is covered. The young larvæ devour only the surface and sub-

ıce of the leaf on the side where they are, leaving the veins and the osite epidermis untouched, producing a 'skeleton' leaf. As they row older, however, they devour all portions of the leaf, and often eat lso the petioles and tender stems. Opportunity has not been given) determine the exact length of the larval life of this insect, but judg- g from observations made, this cannot greatly exceed a week. Par- ıes living in the region where the insect was present in great numbers ;ive ten days as the length of the time in which the chief destruction ras accomplished."

On attaining its full growth the worm spins up, amid the débris on the ground at the base of the plant, in a delicate brownish cocoon of irregular shape, and transforms to pupa, in which state it remains from one to two weeks.

NATURAL ENEMIES.

There is little to say under this subhead. From our correspondents it would appear that an occasional lady-bird (species not determined) destroys it, while various ground-beetles (genus *Harpalus* and *Calosoma*) also feed upon it. Professor Popenoe (*loc. cit.*) states that he has bred a *Tachina* from it, and is under the impression that "this parasite is ordinarily present in sufficient force to be a considerable check upon the increase of the caterpillar," as he had seen frequent evidence of the latter being parasitized. For the rest, it will find enemies in all the common predacious insects in the regions where it abounds. The insect is, also, less abundant where poultry have the run of the garden.

REMEDIES.

The only remedies that seem to have given satisfaction (though there is abundant opportunity for further experimentation) are the arsenical poisons. Of these London purple and Paris green are the chief forms used, the former being the cheaper and preferable on account of its color. We understand that it can be readily obtained in accessible towns in Kansas for 8¾ cents per pound by the barrel. This poison can be distributed in any one of the various ways that have been described in our several reports. The method most satisfactory and the particular method will depend on the particular crop to be protected. In broad grain and cotton fields, where the exigencies of the case warrant the expenditure, there is no better method than by the use of the barrel or tank pump, with the cyclone nozzle, figured and described in our reports for 1881–'82, and 1883. A simpler method is to mount an open barrel in a cart and employ one or two men with a fountain or aquapult pump to spray broadcast on either side. A greater amount of ground can be gone over in this way than in any other, and if care be taken to use sufficiently fine spraying-nozzles, that will not clog, this method will give great satisfaction as being, all things considered, the cheapest. In limited areas or gardens the poison may be sifted dry.

The fact that the worms surround themselves with more or less of a does not in the least protect them from the poison, and they are ly killed, as shown by the results of experiments tried in Kansas . We may quote, as an evidence of the good to be accom- by po ning in the simplest and crudest way, from an article R. G t, of Crawford County, Kansas, republished from the P in the Report of the Kansas State Board of Agriculture nth ending June 30, 1885, p. 17:

> have learned this morning of a plan used by one of our enterprising farmers cality to kill these pests. He is using Paris green, dissolving it in hot water,

and applying it with an ordinary sprinkler. The proportion he uses is about a tablespoonful of Paris green to one-half gallon of water. Yesterday he had nine men at work in his field with sprinkling-pots, and they went over about 50 acres of corn. He has one man drive through the field with a water-tank or barrels of water in a lumber wagon, and the rest of the men with sprinkling-pots to sprinkle each hill with this solution of the Paris green. He puts sealing-wax on the sprinkler of the can, so as to close up all the holes except about a dozen in the center, thus avoiding a waste of the solution on too much of the ground around the hill, and throwing the stream directly on the plant. He tells us that this plan is very successful, and kills most of the worms within a half hour after it is applied, and what few worms are left appear to discontinue their work.

A simple method which was put into operation by one of our correspondents, Mr. Jacob Nixon, of Kellogg, Cowley County, Kansas, and which might prove of some avail where the worms are numerous, is described as follows:

I attached a cracker-box lid to the forward cross-piece on my cultivator frames by wire and staples, forming a hinge. This is raised by the corn, and, swinging, strikes the next hill in a nearly vertical position, jarring the worms to the ground, where they are covered by the dirt. I did not stop to see whether the larger ones burrowed out, but I know that I cleaned them out fast.

THE DARK-SIDED CUT-WORM.

(*Agrotis messoria*, Harr.)

Order LEPIDOPTERA; Family NOCTUIDÆ.

[Plate VII; Fig. 1.]

INJURY TO ONIONS—NEW HABIT.

This insect was treated of in our last annual report (p. 290) under the general head of Cabbage Cut-worms, and is here refigured and mentioned because of its appearance the past summer in enormous numbers in the onion fields of Orange County, New York.

Our first intimation of the existence of this pest was through letter and specimens received June 11, from Hon. G. W. Greene, of Goshen, in which he stated that the worm was destroying the onion crop in his vicinity and threatened extinction to a large and growing industry. The annual value of the crop in the vicinity of Goshen alone he stated to be half a million dollars.

Mr. John B. Smith, and Mr. Thomas Bennett, a practical gardener of Newark, whom we had engaged for a short time to perform certain practical experiments with insecticides, were sent to Goshen to study the facts and surroundings, and in obedience to a request from Mr. Greene we sent him a letter for publication giving him such knowledge as we then possessed on the subject, and quoting our general recommendations for the destruction of Cut-worms, as given in our last annual report (pp. 298–300).

HABITS AND NATURAL HISTORY.

It will be seen from what we stated of this insect in our last annual report (p. 290) that it is a very wide-spread species, occurring from the Pacific to the Atlantic, as far north as Quebec and as far south as Missouri, and that so far as we then knew, it had the normal habit of the group, *i. e.*, was single-brooded, the moths occurring during July and August, after a duration in the pupa state of a month or more. This

ural history was based upon observations made in Illi-
ınd i, and we were much interested in ascertaining whether
s would be any departure from these habits in New York, especially
e to the species being single or double brooded, as much of
r of any practical recommendations would depend upon the
s.

Therefore made every effort to ascertain the facts in the case, and,
the pposition that there might be a second generation of worms, we
d Mr. Smith pay two other visits to Goshen, one early in September
d ly in October, with a view of making additional observa-
r office notes show that nearly full-grown larvæ were received
Goshen on June 18 and 26, from the onion patches, and that addi-
ıl larvæ were received July 24 and 30 from Trenton, N. J., where
ey had been feeding on cabbage.

The moths from the first lot of larvæ (from Goshen), issued July 25,
and 29, while those from the second lot (from Trenton) made their
pearance August 11, 17, 18, and 28. A few pupæ, obtained the first
ek in September, gave out the moths September 8, 9, and 10. This
responds very well with our previous experience, the more northern
itude accounting for the somewhat later appearances in New York
an in Illinois and Missouri.

At Goshen all the larvæ had apparently transformed by September 2,
e date of Mr. Smith's second examination. This second visit was
dertaken in consequence of a report that a second brood of worms
d made its appearance and was damaging the neighboring oat fields;
t, as it turned out, this report arose from the presence of the Army
(*Leucania unipuncta*) in the oats. The onions had ripened and
re largely gathered, many fields having been replanted in corn, oats,
turnips in consequence of the damage done to the onions by the
. A more careful search through the onion fields showed no
of the eggs, larvæ, or moths, but by digging he found a few pupæ
sed in earthern cells some 4 inches below the surface of the ground.
were very scarce and he found no empty shells to indicate that
had been more abundant. The probabilities are that a vast ma-
ity of the larvæ fell a prey to Tachina flies, the eggs of which were
ticed on a very large proportion of the larvæ in June.

A further examination at the beginning of October failed to reveal
y ces either of eggs, larvæ, pupæ, or moths in the vicinity of the
n ıl onion fields, save a few empty pupæ shells in the same locality
e the pupæ were found in September. There had been at this time
severe enough to form ice, and it is safe to presume that the
for the development of the species had at that time ceased.

From the experience of the year it is evident to our mind that there
no second generation, and that, therefore, the previous observa-
n the West have been confirmed on this point. Both Mr. Smith's
nation and our own office notes are entirely negative in throwing
er light on the method of hibernation, and, as we know from our
mer experience that the full-grown larvæ are found early enough in
season to injure the buds of fruit trees—the best evidence that they
ve hibernated—and as the larval hibernation is by far the most com-
among the Cut-worms, we are still of the opinion that the species so
es as a rule, even in New York State.

es not, however, preclude the hibernation of some of the later-
moths, and the fact that neither moths, eggs, nor young larvæ
in October must, we think, be explained on two grounds, (1)
and insufficient search, or (2) their occurrence in adjacent

localities or on other plants. There are no fixed rules which can al be depended on in the life habits of these insects, as exceptional o rences, such as this wide-spread injury to onions around Goshen, are probably due to exceptional conditions. Thus, while the normal h may be to hibernate in the larva state, exceptional climatic condi may bring about an exceptional hibernation of the moths. This w seem to have been the case in this instance, more especially as the in which they occurred has for the last few years been planted to o season after season. Unless the onion fields were allowed to get weedy in the fall (which is not the case) the larvæ could not well de so as to hibernate in any quantities in the field, and the methods of ure, as well as the condition of the larvæ in June and their ab October, all point to spring hatching. The worms had not been see fore, and the moths most probably concentrated on the fields in spring. We have, however, no records of captures of the moths than September 10.

We regret not to be able to give a description of the eggs or o place of oviposition, but it is not at all improbable that they are on many different plants or even upon shrubs which the larvæ, on l ing, abandon.

REMEDIES.

In our last report the subject of remedies for Cut-worms was consid in a general way as applying to all of the species there treated of, a this particular case, the circumstances being more or less peculiar general recommendations must be somewhat modified to suit. We said nothing about the peculiar conditions connected with this outbreak, nor have we mentioned the remedies tried by the oni ers, as these are described both by Mr. Smith and Mr. Bennett i reports, which follow.

We believe that the crop can be grown successfully even in a cut-worm season by adopting the following measures:

As a preventive we would treat the land early in spring wi mixture of lime and ashes (preferably wood ashes). This mixture be spread lightly over the land, after plowing, and harrowed in.

If, after the seed is sown and the plants have begun to come up worms still appear and threaten damage, we would employ the pois ball system described on pages 299 and 300 of our last annual re This, in brief, consists in placing along the rows, at a distances of 20 feet apart, small bunches of fresh-cut grass or other green plant bage leaves where available), which have been previously sprinkled dilute Paris green or London purple. By this means nearly all o worms can be destroyed with a minimum of trouble.

If, as is very improbable, the worms should still appear in gr bers, by migration from surrounding fields, we would sprinkle the at night, while the worms are at work, with a dilute emulsion of sene. Mr. Smith shows that pure kerosene has been tried at Go with the effect of killing the worms and simply blackening, bu killing, the onion tips. We are not satisfied, however, that the use of pure kerosene would not seriously injure the plants, an recommend instead an emulsion as being safer and much cheaper, just as effective in killing the worms. The kerosene is emulsified soap or milk in order that it may be readily diluted with water. the proper preparation and application of the emulsion a good pump is needed, but beyond this no apparatus is necessary. The formula for this preparation is that given on page 331 of our last a

t. There is little doubt but that by a thorough spraying of the at night with this mixture the worms can be destroyed by whole- It should be used most thoroughly at the points in the field the worms are first noticed to work, and from which they spread rounding portions. The first appearance should be watched for the greatest care, and should be followed by the most energetic s to destroy them.

now give the reports submitted by Mr. Smith and Mr. Bennett, ıg that in the case of the latter gentleman we do not indorse all ggestions, but give them for what they are worth as coming a pr tical gardener. As will be noticed, these suggestions are ıpported by any evidence of actual experiment in the onion fields.

REPORT OF JOHN B. SMITH.

JUNE 18, 1885.

R SIR: In pursuance of your letter of instructions of the 15th instant I went to n yesterday. I had notified Mr. Greene, who met me at the depot, and piloted ound among the farms most infested.

m farming is here carried on extensively in low meadows, drained swamp land, like, and several hundreds of acres form one vast onion field. The persons en- n onion farming are largely small holders, cultivating 1, 2, or 3 acres, or outs, and dependent upon this crop for support. The crop requires constant ut no severe labor, and the whole family, from the baby up, turn out to help. ki upon this vast field from a ridge, it appeared beautifully green in places, by ugly bare patches, sometimes an acre or two in extent. These patches ue the work of the Cut-worm, of which I sent you a large number of specimens terday's mail.

rywhere through the fields were men, women, and children, engaged, as inves- n proved, in hunting Cut-worms, and with such success that three little girls cked in the morning a three-quart pail full. In one spot, less than 15 inches , I saw 40 full-grown larvæ taken, and, while they are not everywhere so abun- yet one could gather half a dozen by simply turning over the earth for a short ce along a row.

- is only one species. The difference in size, difference in color at various stages, ence in habit at different periods of growing led to the idea that more than ecies was engaged in the work. I ascertained by inquiry from several farmers e larva appeared some two weeks since, or as soon as the onions had fairly l, and were, when noticed first, between one-fourth and one-half an inch in —most of them nearer to the latter measurement. At this period of their lives ere difficult to distinguish from the earth in which they hid; but early in the g they came out, climbed to the tops of the stalks, and ate downward. They n such numbers that one man said he was fairly discouraged looking at them. was a larva to every stalk, and sometimes more than one. Curiously enough few oisons, but every one turned out what force he could muster, and all night long, light of lanterns, gathered Cut-worms. As the worms increased in size, they climbing and cut off the stalk at the surface of the ground; this change of is very easily explained by the fact that the slender onion stem would not bear ight of a fat grub. Still, with all their exertions, the farmers did not succeed in ing the enemy, and many small farmers lost their entire crop, a loss of some $200 acre. It was observed that the insects started from centers, and spread in direction from those points. Some genius noticed this, and advised isolating patches by ditching. This was tried and proved successful to a great extent the sides of the ditches were made perpendicular. The earth is friable, and the could not get out of a ditch 12 inches deep. Some patches were saved in this others had already been invaded and were destroyed. Some few escaped alto- , but these were few indeed. I noticed also that weedy fields were less injured lean fields, probably because, there being a greater abundance of food, the dam- he staple was less severe. The onion is easily run out by weeds, and growers ir fields as clear of these intruders as they possibly can. The cleanest fields, suffered most, because there was nothing to eat save onions, and strong ha- no objection to the worm.

riments looking to their destruction had been made. One man used Paris ithout much success, because the onion offers very little surface for an of the poison. Another used pure kerosene, applying it to six rows by s with a brush dipped in the oil. He gathered grubs from other por- ntil 4 a. m., then examined these six rows and found nothing on between the rows, lying on their backs, apparently gasping for

AG—

breath. Next day he saw nothing of these same larvæ, and he gave up the experiment. The kerosene blackened the onion tips, but did not affect the plant otherwise, and I was assured that even pure kerosene might be applied with safety to the plant. This seems to indicate a remedy, for kerosene applied with a sprinkler when the worms are young and climbing (in the night, of course) would kill the ma jority of them. I tried the effect of the oil on a few specimens, and find its rapid and complete, even on the full-grown larva. The younger generation would doubtless be still more susceptible. Not the onion alone suffers from the attacks o this insect; it is everywhere, on all crops, though nowhere so abundant as on the onion meadows. The specimens sent you will enable you to determine if the species i known; if not, there are sufficient to rear. I have kept none but a few alcoholi specimens myself. I found in the fields a single larva parasitized, and send you the parasites. The farmers are scared, for it means distress, and, to some, abs poverty. I gave them such encouragement as I could, and made such suggestio I could for the destruction of the worms. Still, the damage has been done, and prob ably a few days more will witness their transformation into the pupa state.

Last year they appeared in the fields in some numbers, but created no alarm and did no very great damage.

Some parts of these fields are also infested with the larva of an Onion-fly (*Anthomyia*), but this damage they can stand. Nearer to Turner's, some 6 or 8 miles from Goshen, the fly is said to be more destructive than the Cut-worm.

Very respectfully,

JOHN B. SMITH.

Prof. C. V. RILEY,
U. S. Entomologist, Washington, D. C.

REPORT OF THOMAS BENNETT.

SIR: On the 22d instant, by your advice, I went to Goshen, Orange County, New York, to see what I could do in the way of killing the Onion Cut-worms which are doing so much damage there at present. As you directed, I called on Mr. Robert Young, who lives in the infested district.

This place is called Durlingville, and lies about 4 miles southwest of Goshen. The onion district is a large, almost level peat bog, nearly surrounded by hills, about 1 miles long and about the same in width. The public road passes nearly through center, and soon rises and passes over a low hill or bluff which gives a beautiful v of the surrounding locality. This peat bog is variously stated at from 7 to 1(deep, and in some places much more, and was formerly almost covered with which gave it the name of the "drowned" lands; but by a system of ditchi been dried and found to contain the elements of great fertility, not only to also to garden crops.

These lands were formerly owned by a few persons, who disposed of them to a ony of poor people, who purchased a few acres according to their means. An the former land-owners is Mr. Robert Young, who lives upon this bluff, a kind *paterfamilias* to the colony.

So far they have found the onion a very profitable crop, and for several years hav grown it almost to the exclusion of everything else.

The people were all busy at work, each family busily engaged, some weed others using small hand cultivators between the rows of onions, but by far the gre number were busily engaged in hand-picking the Cut-worms or grubs, which lie little under the surface of the ground. This all must do in order to save the cr and keep down the great increase of this most destructive pest, for as yet they h learned nothing better.

The Onion Cut-worm when fully grown is about 1½ inches long, works only at n and during the day lies just under the surface, from 1 to 1½ inches deep. A slight draw of the hand these worms or caterpillars are easily found and can picked up into small vessels, carried away and destroyed. They are there in numbers. It is very common for a family to pick 10 or 12 quarts by day and the number at night by the light of lamps. These most industrious people have to night and day to keep down these pests and save their crops. At night the re all either crawling over the ground or up on the onion leaves eating them. f the larger ones cut the stems close to the ground, and the young onion not l ormed a bulb does not grow again. It seems this pest is only in the beginning career, for last year the damage done was much less than this year, and acc ppearance, if there is not a stop put to its progress, these people must cease nions altogether. But it is to be hoped they are near relief, for these pests thers of a like kind are easily destroyed if taken in time and the proper pplied. It is a beautiful sight to stand on the bluffs and look east and see the plain covered with this valuable esculent, but for the red patches here which mar the scene. After due examination I saw that nothing d long this year kill the worms in the ground without involving too

[illegible] as spreading a thick coating of salt over the ground, &c. I therefore [illegible] to find a repellent or preventive to keep them, if possible, from either [illegible]on or cutting the plants. This could be done only by dusting or sprinkling therefore made powders of different strength with lime and coal-tar, which [illegible]bnoxious to most insects, avoiding, however, making them too strong lest the [illegible]op might be injured. The people all agreed with me that if these powders had been [illegible]t on about three or four weeks previous, when the skin of the caterpillars was [illegible]oung and tender, it would have killed them and saved the crop; but it was hard to [illegible]ake it stick without wetting the leaves, and the people in their present disheartened [illegible]tate, I knew, would not undertake to do it. This wetting could have been done [illegible]asily from the ditches when the plants were about 3 or 4 inches high and the grubs [illegible]mall and tender, but now at this date the young onions are large, over a foot high, [illegible]spread about, and the watering would involve a great deal of labor. I next made [illegible]ons of alum and also of niter (nitrate of potash) separately, and combined in [illegible]qual proportions—made my formulas by weighing the quantity and measuring the [illegible]ater. This also was only partially successful, and of course I could not recommend [illegible]t. I next tried a solution of soft soap, which, by reason of the caustic potash which [illegible]t contains, is an excellent insecticide. This proved very good. I sprinkled the [illegible]olution on six rows across a lot by means of a whitewash brush, and when we went [illegible]out at night to try its effects we could only find three small worms eating on the six [illegible]ows. I made this solution on the 24th instant, at 11 a. m., and to try its effect I [illegible]etted about half a pint of the worms on a piece of old sacking cloth, and in about [illegible]wenty minutes they all appeared dead. This gave great encouragement. I kept [illegible]them till next day and on coming away at 9 o'clock all who saw them agreed they [illegible]were dead. Certainly the solution was strong—about a quart of soft soap to about [illegible]quarts of water. I also tried a strong solution of kerosene and soft soap—1 pound [illegible]of soap boiled in 3 quarts of water and 1 quart of kerosene added and stirred into it. [illegible]I put 1 quart of this mixture to 4 quarts of water and sprinkled it on with a brush. [illegible]I thought perhaps the kerosene would kill the onions, but it did not, and what appears strange, it did not seem to have much better effect than the soft soap alone.

I also tested soft soap and Paris green, soft soap and tar-lime powder. These were very good, but could not say that onions were entirely free from worms.

The remedies I have recommended are as follows:

Soon after the onion crop has been gathered let a good coating of gas-house lime [illegible]; be spread over the ground. Let these lie two or three weeks and then be [illegible]plowed in and harrowed thoroughly so as to mix well with the soil. Also [illegible]ds or open ditches must be cleaned up in the fall of all grass and weeds, and [illegible]which had been suffered to grow out 4 or 5 feet in some places must be [illegible]or skinned off with the spade and then burned. I was told they must [illegible]have a load or more to keep the frost from crumbling down the edge. "Very well," said, "then let a sprinkling of salt or gas-house lime be put over the sod as well as [illegible]over the rest of the ground." These ashes must be gathered up and kept dry till spring and though not nearly so good as wood ashes will serve a good purpose. In early spring, or before, these people must procure a sufficient quantity of wood ashes and mix in the proportion of about one of wood to about four of sod ashes, and this quantity then well mixed with at least one-half its bulk of fresh slaked lime. After [illegible]lo[illegible] in the spring and just before sowing the seed, these ashes and lime must be [illegible]over the ground and harrowed in. It would also be the better at the same [illegible]time for another light dressing of salt. The gas-house lime must be in a fine state, and [illegible]not put on, as we often see it, in large lumps.

To those who cannot get enough of gas-house lime, I have recommended a good substitute, namely, gas-tar. This can easily be reduced to a fine powder by running it [illegible]on a bed of sand, sawdust, or dry peat gathered from the surface with hoes. After [illegible]absorbing all it will take in, it can easily be reduced to a fine powder and can be [illegible]sowed equally and very readily over the ground. This also will destroy both eggs [illegible]and larva of all moths and other insects.

[illegible]Both lime and ashes are excellent as a manure for onions, and I think together with [illegible]salt and gas lime, which will be given in the fall, will yield a plentiful crop [illegible]without the stable or New York manure; besides, insects cannot breed in these mate-

[illegible]To those who cannot procure the above-mentioned remedies I would earnestly [illegible]recommend a change of crop, for one year at least, especially in those plats which are [illegible]infested with either Cut-worm or maggot.

[illegible]I have no doubt but great numbers of the parent moths could be trapped during [illegible]summer by flambeaus and torches and four-faced lanterns, but I think this will [illegible]be unnecessary if the means of the destruction of the worms which I have recommended be fully carried out.

[illegible]I am, sir, most respectfully yours,

THOMAS BENNETT.

C. V. RILEY,
U. S. Entomologist.

THE STRAWBERRY WEEVIL.

(*Anthonomus musculus*, Say.)

Order COLEOPTERA; Family CURCULIONIDÆ.

[Plate VII; Figs. 6 and 7.]

PAST HISTORY.

The first reference that we have been able to trace to this insect as injurious to the Strawberry will be found in the Monthly Report of the Department for November-December, 1871, where Mr. Glover gives an account of its appearance, with the statement from Mr. B. Bryan, Silver Hill, Md., that the weevils were injuring his strawberries soon after these were blooming, the beetle piercing the blossom-buds and the footstalks of the blossom-bud. The insect was there referred to by the name of *Anthonomus signatus*, Say (*bisignatus* Schœnh.). He also showed that no vestiges of the egg or larva could be found. In May, 1873, we found it quite injurious on Mr. H. Weaver's farm near Saint Louis, and our notes show that the injury was done to the blossoms, although the strawberries were at the time out of bloom; that when the weevils are not at work they hide in the flower; and that they were also occasionally found in the blossoms of the Blueberry. Ten years later, or in 1883, Prof. A. J. Cook published an account of its injuries in the report of the Michigan State Horticultural Society for 1883, where he states that it was ruining the crop on Mr. William Chapman's place at Phœnix, Keweenaw County, Michigan, in July of that year, but that it disappeared about August 1. Since then Professor Cook has made no mention of it, from which we infer that it has not again appeared in injurious numbers. Prof. S. A. Forbes, in his extensive article on the insect enemies of the Strawberry, published in the Thirteenth Report of the State Entomologist of Illinois (1883), mentioned this species, but added no new facts, simply quoting Professor Cook's article.

INJURY IN 1885.

During the summer of 1884 this Strawberry Weevil, or Strawberry Anthonomus, made its appearance in a new locality, this time at Rossville, Staten Island, N. Y., on the farm of Mr. Samuel G. Winant. Mr. Winant's crop was damaged to the amount of about $1,500. In May, 1885, the beetle again appeared in countless numbers in the same locality and spread to adjoining gardens. It was at this time that our attention was first called to this outbreak, and we entered into correspondence with Mr. Winant and had Mr. Smith make examination of the circumstances in the field.

Mr. Winant, writing under date of June 15, made the following statement:

* * * Please find inclosed a sample of the Strawberry Beetle. They attac bearing stems just under the hull by boring a hole in the stem, and the forming drops to the ground or dries up. Those which escape and open into white bl are attacked and pierced by these insects. Early in the spring of 1884 I was $3,000 for my crop, but in a few days this party declined to take it on account o damage done by these insects. At first I supposed it was caused by frost. My acres of Sharpless strawberries are entirely used up. If all that are now left ripe at once I am positive it would not amount to a quart to the acre. This is a ver

atter; there are many other growers in this place that are badly troubled st. The strawberries will be cut short and will amount to thousands of s on account of these pests. If we do not find a remedy to exterminate them be so numerous by another year that they will take the entire crop, not but in many other places, for they have made their appearance, I am told, rsey. * * * They are now (June 15) quite hard to find.

facts may be gathered from the following extract from an ublished in the *Westfield* (Staten Island) *Times* of about June

awberry Beetle still continues its ravages, and gradually spreads from farm nd unless something is done to check its career it is doubtful whether any les can be raised in the town of Westfield two years hence. Two years ago their first appearance on Mr. S. G. Winant's vines; last year they destroyed half his crop, and this year they have utterly destroyed his entire crop of Mr. Winant thinks he will not be able to pick one crate of berries from very vigorous vines, and a careful inspection of the vines convinces us that overestimated the damage.

ert Barton, who lives on an adjoining farm, has half an acre of vines, and will berries enough for his own table.

tles appeared last year on Isaac Wort's and John Kern's vines, and this year destroyed about one-half of Mr. Kern's crop, and have entirely destroyed f Mr. Wort's old beds so that he has plowed them up. Mr. Winant has also wing under some of his finest vines. This pest seems to be limited to a itory lying between Kreischerville, Rossville, and Pleasant Plains, but it is arging its sphere of usefulness (?), and has this year made its first appear- number of other farms.

wers have tried experiments with a view to destroying the beetle; but they poisons without destroying the fruit, and they know so little of the nature s of this beetle that they are working entirely in the dark. The Strawberry black, one-sixteenth to one-eighth of an inch in length, and pierces the below the blossoms. The blossom invariably dies from the wound. In a field where they have been at work, it is no unusual thing to see a stem ..ally bore fifteen or twenty blossoms standing perfectly bare.

HABITS AND NATURAL HISTORY.

nith visited Mr. Winant on June 15, and his observations are his own words, as follows:

trawberry patch, about 2 acres in size, I found perfect imagines of the *s* in abundance on the few remaining blossoms. I send in the box some the work done by the insect, and also a vial containing a number of liv- iens, many taken in coitu. All were on the blossoms, and on many blos- were three or four beetles, and all the remaining flowers were more or less large proportion of the berries grown by Mr. Winant are the "Sharpless" nd this is most severely attacked. Scarcely a berry had set, and most of showed the fruit stalk with several dried-up buds, as you will see by the of which I send a number in the box referred to.

rvations and questions have given me the following information: Previous insect had not been observed, and had certainly done no appreciable dam- he spring of 1884 it appeared in large numbers and at once attacked the cing the stem a short distance below the bud, sometimes causing the bud to gain to shrivel and dry up. The specimens in the box show, better than I be, the work of this insect. About half the crop was taken last year (1884); berries of the Sharpless variety are a rarity. The vines are fine and thrifty ng bothers them except this pest. It is said to be confined to a limited dis- I believe it has simply been overlooked elsewhere, and not reported, for I time heard complaints at second or third hand of an insect working as ..e beetle first appeared this season, some three weeks ago, with the first e "Sharpless," and has continued since, moving from place to place as it its work of destruction. I searched carefully for eggs and larvæ in the d been cut off, but without success. I send some of the buds in the box, ..ay have better success.

up the information obtainable as to its history and habits. The beetle een taken commonly enough sweeping in flowery meadows. Not all the strawberries are equally subject to attack. The "Sharpless," and all s which like it are "perfect" bearers, and have similar flowers, suffer nchester," "Jersey Queen," "Gypsy," and others of the so-called

"pistillate" varieties, which are imperfect bearers, are less subject to (though empt from) attack. Until the "Sharpless" and its nearer allies are all destro, others are not attacked. It seems also that only buds and flowers are injured beetle, and where a strawberry has fairly started it is safe. Further, it seem only buds are severed from the stalk, the flowers being simply eaten out a stroyed.

At this time the buds are all gone, only straggling flowers appear, and he there a berry suggests what might have been.

The probabilities are that the eggs are deposited in the buds and that the undergoes its transformations in those that fall to the ground.

Later in the season Mr. Smith made another trip to Staten Is under instructions, in order to learn something concerning the e states of the insect. He visited Mr. Winant on October 6 and spent time in the field, but the most careful search in and on all parts plants failed to show any traces of any larva which could with an gree of probability be connected with this beetle. On the contrar plants were remarkably healthy and vigorous, the only insects being a few specimens of the adult of one of the Strawberry Root-w (*Paria aterrima*), close to the roots underground, evidently in w quarters, and three specimens of the larvæ of the Strawberry C miner (hitherto known as *Anarsia lineatella*).

With a view of endeavoring to arrive at some knowledge of the sible larval habits of the species we shall presently consider its ch ters and its synonymy, the variation which the mature beetle is su to, and the known larval habits of other species of the genus. Fro facts set forth in those connections it is evident that the larval hab the genus *Anthonomus* show great diversity as to food-plant, and d offer any definite clue for the natural history of the species under sideration.

There is, however, a species (*A. suturalis*) so nearly allied to *m* that even Dr. Le Conte has considered that the two may possibly to be the same. Now it happens that we know the larval habits *suturalis*, and the important bearing which this question of the sp identity or distinctness of these two forms has on the habits o strawberry pest, as well as the insufficiency of previous descrip justifies the classificatory and descriptive details which we have en into at the end of this article, and which lead to the conclusion notwithstanding the great similarity of the two forms, they shou considered as distinct species. We are justified, however, in inf that *musculus*, on account of its relationship with *suturalis*, may prove to have similar habits, *i. e.*, to breed in similar kinds of gall possibly in the numerous *Phylloxera* galls on Hickory.

Musculus is an abundant species and is distributed throughou Atlantic States, occurring from Massachusetts and Michigan to Fl and Texas. It is to be found throughout spring and summer on all of flowers and flowering trees and shrubs, and in winter time the l finds shelter under old leaves and other débris in our woods and dens. That it does not breed upon the Strawberry plant is not proved by the failure of all observers to find any trace of its lar that plant, but also by the fact that the beetles are abundant in l ies where strawberries are comparatively rare or almost absent.

NATURAL HISTORY OF OTHER SPECIES OF THE GENUS ANTHON

Mr. B. D. Walsh first records* the fact that three of our American species of *Anthonomus* are, in the larva state, inquiline

* Proceedings Entom. Soc. Philadelphia, iii, pp. 547, 619, and vol. vi, p. 365,

by other insects. He states that *A. suturalis* is inquilinous
ne is made by *Phylloxera caryæ-globuli* Walsh, and *Ph. caryæ-*
i (] cu), upon the leaves of hickory trees, and that *A. sycophanta*
lsh,* was bred by him in large numbers from various Saw-fly galls
willows. A third species, *A. cratægi* Walsh,† was obtained by him
Cecidomyidous gall (*C. cratægi-plica*, Walsh) on Thorn (*Cratægus*
i).

we have on several occasions bred *A. sycophanta* from the Saw-fly galls
by Mr. Walsh. Still more frequently we have found upon
Phylloxera galls on Hickory (and particularly *Ph. caryæ-gum-*
ley, and *Ph. caryæ-globuli* Walsh) specimens of the typical *A.*
; but those so obtained show no variation in the direction of the
A. *culus* nor of its varieties as presently indicated, and this
t conclusions presently drawn from other considerations,
a. *ralis* is specifically different from *A. musculus*. We have
found, with Mr. Schwarz, a third species (*A. flavicornis* Boh.),
close affinity with *musculus*, inquilinous in an undescribed Ce-
idous gall on the leaves of *Solanum eleagnifolium*, in Texas.

we have just seen that the breeding habits of four species having
ffinity with *A. musculus* have been ascertained, and from this anal-
y we might conclude that this last-named species would also be, in
e larva state, an inquiline in some gall made by another insect. Un-
tunately, however, the "unity of habit" is by no means preserved in
e genus *Anthonomus*, at least so far as our North American species are
n . Among the species allied to *A. musculus* there is still one
wh the breeding habits are known, viz, *A. juniperinus*, Sanborn,
eds in *Podisoma*, a tough fungus on juniper trees. Among the
ecies we hardly need refer to *A. quadrigibbus*, Say, because it
too well known as the Apple Curculio, its larva living within

Another very large species, *A. grandis*, Boh., we have reared
u Department from dwarfed cotton bolls sent from Northern Mex-
y Dr. Edward Palmer. Mr. Schwarz has observed the oviposition
A. gularis, Le C., in the blossoms of *Cassia marylandica* (Bull. Brook-
l Ent. Soc.).

Turning our attention to the European species of *Anthonomus*, we
da summary of the species observed in the larva state in the admira-
work of Éd. Perris, "Larves de Coléoptères" (p. 401). Six species,
pomorum, *pyri*, *druparum*, *pruni*, *pedicularius*, and *rubi*) are known
oviposit in the not yet opened blossoms, chiefly of fruit trees, the
væ living within the blossoms which they prevent from further de-
nt. A single species, *A. spilotus*, forms an exception to this rule.
ts one egg within the young, not yet unfolded, leaf of the pear
either by the egg-puncture of the parent beetle or by the action
ne young larva this leaf remains rolled up, thus forming an excellent
elter for the larva which feeds upon the substance of the leaf.

The larvæ of all known species of *Anthonomus* never enter the ground,
ransform to pupa within the blossom or fruit they have attacked.

REMEDIES.

little was done in the way of experimenting with remedies. The
of a patent mixture, known as Dr. Wolf's Vermin Soap, visited

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cies is also closely allied in shape and sculpture to *A. musculus*, but the
ot shining, and the sculpture of the thorax is very coarse.

ngs to the group of *Anthonomus*, in which the funicle of the antennæ is

the field, and as we learn from the *Westfield Times* of June 20, 1885, wa quite successful. The report of our Indiana agent, Mr. Webster, how ever, would indicate that this remedy does not accomplish all that i claimed for it.*

As soon as the life-history of the species has been made out we ma be able to indicate some cheap and wholesale method of extermination but until then we shall have to rely upon such remedies as can be ap plied to the beetles themselves while at work. Here the difficulty a that the beetles are abundant everywhere, and are constantly c to the strawberry patch. Hence a field treated one morning so that a of the beetles are killed, may the next day be swarming with them agai The kerosene emulsion may doubtless be used advantageously, whil pyrethrum (either mixed with flour in the proportion of 1 part to 15, an dusted over the plants while the weevils are at work, or stirred wit cold water, at the rate of 200 grains, or 13.6 grams, to the gallon, an sprinkled on the vines) may also prove serviceable.

As repellants, gas-lime and sawdust impregnated with carbolic aci well scattered through the field, might prove of some benefit.

CHARACTERS AND SYNONYMY.

As already stated, this strawberry pest was referred by Mr. Glov to *Anthonomus signatus*, Say, and a number of our own specimens agr so closely with Say's original description of *A. signatus*, as well as wit Dr. Le Conte's description,† that there can hardly be any doubt a the correctness of the determination. A number of other specimen however, which we sent to Dr. Le Conte, were returned to us with th determination "*A. musculus*, Say," and trusting to Dr. Le Conte's au ity we have, in our correspondence, referred to this strawberry p *A. musculus*, Say. In order that the reader may judge of the difficu in coming to a decision regarding the two supposed species we r here Say's descriptions:‡

A. musculus.—Dull rufous; scutel and elytral spotted bands whitish.
Inhabits United States.
Curculio varians, Melsh. Catal.
Body more or less dull rufous or piceous, punctured; head piceous; rostrum wi elevated lines; antennæ rufous; club dusky; thorax piceous, very much crowd with punctures; small recurved distant whitish hairs; scutel oval white: elytra wi dilated impressed striæ of large punctures; rufous with edge piceous; two o undulated, macular, whitish bands of short hairs: beneath piceous; feet rufou
Length, including the rostrum, one-tenth of an inch.
Var. *a.* Obscure piceous, almost black; bands obvious.
This varies considerably in its depth of coloring.
A. signatus.—Body with numerous, prostrate, white hairs: rostrum longer tha the head and thorax, slightly arquated, linear, lineated; scutel oval; elytra sa guineous, with punctured, impressed striæ; region of the scutel to the middle o suture, and band of three large, unequal spots behind the middle, brown.
Inhabits United States.
Length less than one-tenth of an inch.
I adopt the name proposed by Schönherr, in preference to that of *sanguinipe* nder which I described it.

It will be seen from a comparison of these descriptions that rences given between the two species are merely those drawn r oloration.

Turning to Dr. Le Conte's tabular arrangement of the species thonomus (*Rhynchophora*, &c., p. 195), we find that he disting

* See Bulletin No. 11, Division of Entomology, U. S. Department of Agriculture.
† The Rhynchophora of America north of Mexico, p. 199.
‡ Complete writings of Thomas Say, edited by Le Conte, i, p. 277 and p. 293.

the two species mainly by the structure of the antennæ, *A. signatus* ing the funicle of the antennæ slender, with the second joint longer than the third, whereas *A. musculus* (and a number of other species) has the funicle less slender, with the second joint equal to the third. This is the difference also upon which he separated them in correspondence with us in 1873. In his description of *A. signatus* (*l. c.*, p. 199), he says, however: "The second joint of the funiculus of the antennæ is perceptibly longer than the third, but not so much so as in the preceding species. It therefore forms a passage to the small species which compose the next group."

Thus the importance of the antennal structure as a means of distinguishing between the two species is already weakened by Dr. Le Conte's own statement. Moreover, upon examination of a large series of specimens collected on strawberry plants, we find that the length of the funicle of the antennæ as well as the relative length of the second and third joints are subject to variation. In some specimens the second joint is distinctly longer than the third, while in other specimens the difference is hardly noticeable. The outer joints of the funicle are sometimes nearly rounded and sometimes distinctly transverse, *i. e.*, wider than long. The same variation may be noted in other allied species of this genus, and it is safe to assert that Dr. Le Conte has overrated the importance of this character. Thus, in the absence of any other distinguishing character of any constancy, it would seem to be advisable to unite the two forms under one specific name. In this case this name *musculus* Say must be adopted as having priority.

How greatly the coloration varies may be gathered from the tabular statement given in connection with the redescription. Still another species must be mentioned in this connection, *A. suturalis*, described and figured by Major Le Conte (Ann. Lyc. Nat. Hist., New York, i, p. 171, pl. xi, Fig. 9), and placed by Dr. Le Conte (*Rhynchophora*, &c., p. 200) immediately before *A. musculus*. Mature and well-developed specimens of *suturalis* are at once distinguished by the coloration of the elytra, which are black, with a large red or bright orange-colored spot on the apex, the suture alone being black. However, this red spot varies in extent, and specimens in which the elytra are nearly entirely red come extremely close to the more immature specimens of *A. musculus* (as we have already shown, p. 278), so that Dr. Le Conte says himself of this latter species (*Rhynchophora*, &c., p. 201): "Smaller and more robust [than *suturalis*], with the beak more slender, and the funicle of the antennæ with the outer joints more rounded. I can find no other differences worth mentioning, and it will very probably be found to be not distinct."

DESCRIPTIVE.

Anthonomus musculus, Say—General shape oblong, narrowing anteriorly. Average length, 2^{mm}. Head black, nearly opaque; sparsely and obsoletely punctulate; with a few hairs fringing the eyes, and with a punctiform impression between the eyes; beak distinctly longer than the head and thorax, slightly curved, obsoletely tricarinate above, extreme tip shining and impunctate; antennæ honey-yellow, second joint of funicle slender, about half as long as the first and nearly twice as long as wide, the following joints rounded or even subtransverse; club blackish, oblong. Thorax wider than long, narrowed and constricted anteriorly, sides rounded, base slightly bisinuate, upper side shining, densely and rather strongly punctate, sparsely pubescent, the pubescence longer and denser in front of the scutellum, which is oval, and densely covered with white pubescence. Elytra at base much wider than the thorax, about two-thirds and times longer than wide, convex, shining, variable in color, very broadly rounded behind the middle, shoulders well marked, sides straight, at tip rather abruptly rounded: punctate-striate, striæ rather shallow, but the punctures within them a little wider than the striæ, impunctate; pubescence variable, usu-

ally consisting of scattered whitish hairs and two narrow transverse bands behind the middle united at the suture. Under side black or reddish-piceous, nearly opaque, pubescence denser than on the upper side, abdominal segments finely punctulate. Legs slender, femora with a small, acute tooth, that on the hind femora being very small.

The more conspicuous color varieties may be arranged as follows:

Variations of Anthonomus musculus.

(*a*) Elytra blood-red, each with a large blackish spot behind the middle, extending from the margin to the third stria, and with another but smaller spot near the suture; both spots margined with a fringe of whitish pubescence (*bisignatus*, Gyll.).

(*b*) Like the preceding, but the small spot is wanting (*signatus*, Gyll.).

(*c*) Like the first, but the fringe of pubescence nearly or entirely wanting.

(*d*) Like the first, but the large spot does not reach the margin.

(*e*) Elytra dark reddish-brown, or piceous, or black, the large spot and the fringing pubescence more or less distinct.

(*f*) Elytra uniformly reddish or brownish, spot obsolete or wanting, whitish pubescence very scanty or almost entirely absent (*musculus*, Say).

(*g*) Elytra black or piceous, tip blood-red, pubescence evident or absent.

(*h*) Elytra brownish or reddish-brown, suture and side-margin black.

The color of the legs and thorax varies from reddish-brown to piceous-black, independently of the color of the elytra.

Comparative Differences between Anthonomus suturalis and A. musculus.

A. suturalis Le C.	*A. musculus* Say.
Average length, 2.3mm to 3mm.	1.6mm to 2.8mm.
General shape.	
Oblong; sides parallel.	Less oblong; somewhat widening behind.
Beak.	
Punctation usually finer, sparser, and less distinct; carination indistinct.	Punctation stronger and denser; carination more distinct.
Antennæ.	
Funicle more slender; outer joints almost longer than wide; club less abruptly formed.	Funicle stouter; outer joints globular or even subtransverse; club abruptly formed.
Thorax.	
Less transverse; sides less rounded; apical constriction more distinct and longer; upper side very shining; punctations coarser and (usually) less dense; hairs very fine and short.	Transverse; sides rounded; apical constriction short; upper side less shining; punctations finer and denser; hairs coarse and longer.
Elytra.	
Twice as long as wide; hardly widening behind; striæ a little deeper; punctures within them coarser; pubescence very sparse and fine, never forming transverse bands. Color black, with a large usually well-defined apical spot yellow or red; suture always black.	Distinctly shorter (1⅓ times as long as wide); widening behind; striæ less impressed, with the punctures less coarse; pubescence coarser, usually forming two transverse bands. Color red, or brown, or black, with or without a black spot behind the middle; very rarely black, with the tip indistinctly dark red.
Habits.	
breeds in Phylloxera galls on hickory leaves, and is frequently found in such galls, but has never been found injuring strawberry blossoms.	Frequently found injuring s wh blossoms, but has never been Phylloxera galls on hickory leaves.

THE PEAR MIDGE OR PEAR DIPLOSIS.

(*Diplosis nigra* [?], Meigen.)

Order DIPTERA; Family CECIDOMYIDÆ.

[Plate VII; Figs. 2, 3, and 4.]

ave for some time been interested in an insect which has ap-
in a limited region near Meriden, Conn., confined almost entirely
large fruit farm of Messrs. Coe Bros. In the spring of 1881
entlemen had some slight correspondence with the Department,
h no mention has been made in the reports, and there the matter
)pped until June, 1884, when they wrote to us in reference to the

ill be seen by what follows, there is every reason to believe that
an introduced species; that it has been introduced within quite
years, and that it is so far confined to a very limited region. It
hese reasons that we call particular attention to it now, as we
he meeting of the Mississippi Valley Horticultural Society held
Orleans last January, where we urged, as we would now urge,
me decisive steps be taken to stamp it out. If, as we now believe,
w pest is confined to the orchards of the Messrs. Coe and such
iediately adjoin them, it seems to us that some such society as
rican Pomological Society would be justified in empowering a
ree to especially look into the matter and effectually destroy
crop within the limits of the insect's present distribution in this
; for two or three consecutive years, compensating, if need be,
ners for the loss of their crops.
ew of the immense losses sustained within the last twenty-five
y the spread of introduced injurious insects, which might in the
ing have been stamped out or kept out by proper concert of ac-
e cannot urge too strongly such action in this case.
der to learn all possible facts in reference to the insect, we had
ith visit the locality, instructing him to collect a large amount
rial, to ascertain whether the larva leaves the fruit for pupation
the fruit falls or afterwards, and more particularly to collect all
earing upon its possible importation and upon its distribution.
ith's report was published in our last annual report (pp. 396–398)
ed not be repeated here.

LIFE HISTORY AND HABITS.

a careful rearing and study of this insect in the office, and from
ondence with the Messrs. Coe, as well as from Mr. Smith's report,
summarize the insect's history in America as follows:
eggs are laid in the spring, in the flower end of the fruit, as soon
ven before it "sets." The fruit grows and soon assumes a some-
istorted appearance, or, as Mr. Smith says, "an irregular, some-
nobby" look, or occasionally seeming abnormally round. If one
young pears be cut open, its interior will be found to be chan-
ooved, the seeds separated and eaten into, and the entire
ized. Surrounded with excremental pellets and partly im-
the flesh of the fruit will be found from ten to thirty little
white maggots, which, as they grow, absorb more and more of

the pulp, usually, however, attaining their full growth before the inte rior of the pear has been entirely consumed. When full grown they leav the fruit either through the calyx end or through some crack or soft spo and drop to the ground, working their way underneath the surface.

The larvæ (Pl. VII, Fig. 2) progress, as do other species of *Diplosi* by a series of skips or jumps, by which they fling themselves an h (more in a horizontal direction. The anal end of the body is curved u until it reaches the posterior margin of the first thoracic joint, the ant rior end of the body being also somewhat curved downward, and is the suddenly snapped straight with such force as to lift and throw the wl body.

From observations made by the Messrs. Coe, it seems that af larvæ are full grown, or nearly so, they leave the fruit, preferably du a rain-storm, or are forced from it by the rain penetrating the cra the fruit. The following extract from a letter dated June 12, 1885. upon this point:

> Our men had gone over the orchard once, picking all that they could find, and w going over it a second time when a violent rain-storm obliged them to quit hour or two. Returning after the rain, they observed that a basket that hau left out in the storm with 2 or 3 quarts of the wormy pears was alive with the l hopping about like so many fleas. They had all left the fruit and were trying to es from the basket. Upon examination we found that the infested fruit on the trees l no larvæ. So the work was not so thoroughly done as we had intended.

Mr. Smith's observations prove that the larvæ reach the ground dropping from the tree, after which they immediately seek to hi themselves beneath the surface. They burrow to a greater or l depth, depending on the porosity of the soil, but rarely exceed an i They remain for a considerable time (just how long is not yet d mined) in the naked larva state before commencing their cocoons, a then in the cocoons for another length of time before transforming pupæ (Pl. VII, Fig. 3, *c*).

The cocoon is whitish, thin, but tough, oval in form, and covered w adhering grains of earth.

There is but one annual generation. The larvæ which go into ground about the 1st of June remain there, either as larvæ or pu until the following spring. This is proven definitely by our obser tions at the Department. From a lot of pears received from Mr. Sm June 10, 1884, the larvæ went into the ground almost immediately the flies issued as follows, the earlier ones being influenced to pr ture development by the warmer temperature of the vivaria:

	Specimens is
January 9, 1885	
January 15, 1885	
January 28, 1885	
January 30, 1885	
February 2, 1885	
February 7, 1885	
April 9, 1885	
April 10, 1885	
April 11, 1885	
April 12, 1885	
April 13, 1885	

The Messrs. Coe were led to suppose that the insect might be dou rrooded by finding pears as late as August infested with similar out from pears sent August 31 for examination nothing but nu specimens of a species of *Drosophila* were bred, and these had doub been attracted by the diseased or rotting condition of the fruit.

In giving out the adult fly the pupa breaks through the coc orks its way through the earth to the surface, struggling until

the whole body is in the air and the anal end only is held in the earth. The skin of the thorax then splits longitudinally and the adult fly (Pl. VII, Fig. 3, *a*) makes its escape.

PARASITES.

Three specimens of an undetermined species of the genus *Platygaster* were found in the breeding jar containing the infested pears, on April 9 and 11, and had evidently been parasitic upon the larvæ of the Pear Midge, although no parasited cocoons of the latter were found. No other insect was contained in the jar, and there is little doubt of the parasitism. As will be shown later, there is a strong probability of the importation of this midge from Europe, and this parasite may very readily have been brought over with it. There are more than one hundred described species of the genus *Platygaster* in Europe, the descriptions of many of which are inaccessible. Walker's species, of which there are sixty-nine, are very insufficiently described. Hence there will be great difficulty in determining this species, and we hesitate to describe it as new.

REMEDIES.

No better, simpler, or more satisfactory remedy can be devised, in the light of what we now know of the habits of this insect, than that used the last season by the Messrs. Coe, which is to strip the fruit from the trees in an "off year" and destroy it either by burning after covering it with kerosene, or by feeding to hogs before the insects have a chance to escape. This should preferably be done about the middle of May, or before the larvæ have attained full growth. So far as known at present the insect infests no other fruit than the pear, and it ought not to be impossible for the fruit-growers around Meriden to practically exterminate this pest in a single season. In 1884, this remedy was tried on the Coe place, but the insect reappeared in the spring of 1885, in greater numbers than expected, which showed that the picking was not done as thoroughly as supposed, or was done too late, or else that the insect had gained a good foothold in neighboring orchards in which the picking was not tried. In a letter dated June 12, 1885, the Messrs. Coe give the result as follows:

> Our method seemed to answer for all practical purposes, as they had not come this spring in sufficient numbers to do damage by diminishing the crops. This is the bearing year for our orchards and the trees all blossomed abundantly. The insect confined itself to its favorite pear in the main. None were found in Anjou or Seckel and few in other varieties besides the Lawrence. The 125 trees of Lawrence had perhaps one-sixth of the fruit infested.

IS IT AN INTRODUCED SPECIES?

That this insect has been recently imported from Europe seems quite probable, for the following reasons:

(1) Until this insect was found upon the Coe farm, no insect of similar habits was known in this country.

(2) An insect of almost precisely similar habits and of identical appearance (except for certain discrepancies which can be explained away) has been described by European authors, and, as early as 1831, did considerable damage to the pear crop in parts of Europe.

(3) In 1884 Mr. Coe said that some seven years since he imported a quantity of pear stocks from France, upon which were grafted American varieties: prior to that time he had never seen the insects. A year or two afterward they were first noticed, but in small numbers, and

since then have been on the increase. Mr. Coe is the only one section of the State who has imported pear stocks, and his far the first, and for some time the only one, infested.

For purposes of comparison we quote Schmidberger's account habits of this European species (*Cecidomyia nigra* Meigen):*

The number of eggs which these midges lay in a pear appears to be vario sometimes found only a few larvæ in one pear, and sometimes more than The eggs are hatched in a short time, particularly if the weather be warm; from the fourth day of their deposition, I found the small larvæ on the embry blossom, into which they began to bore, usually in or near the stem of th Before the blossom is expanded they descend to the core, so that they may no posed to the sun's rays; which, as has been already said, would endanger t istence. They separate at the core and begin to devour on all sides. When th consumed the pulp of the small fruit, they have attained their full size, a wait for a favourable opportunity to leave their still secure dwelling and house. This opportunity presents itself after the first rain; because the litt being hollowed out, begin to decay here and there and become cracked, by means an opening is afforded to the larvæ to make their way out. As soon get on the surface of the little pear, they bend themselves together and make to the ground to bury themselves. That these larvæ are not injured by such on the ground I am perfectly convinced. I let a larva fall from a height on the floor of a room three times running; I then laid it on the earth in a gl in a few seconds it buried itself.

If no rain happens at the time they have attained their full size, they so gnaw an opening through the skin of the little pear; they usually, however together in the core till the pear falls off and is bruised by its fall on the when they obtain an outlet. They often remain a long time in the pear on the if they cannot obtain a passage out. I gathered some pears that were outwa injured by them, and laid some of them on a board in the room, and others on t earth in the glass; and I found the larvæ still in the pears in the middle of July, s they were externally completely withered or decayed, and covered with m took them out of the pear and laid them on the earth in the glass, and most even in July, buried themselves there.

In the year 1831, the larvæ of the Gall and Pear-midges had attained their from the 14th to the 20th of May; but in 1832, not until from the 20th to t because the coldness of the weather that spring greatly retarded the growt fruit. They have, therefore, generally nearly four or five weeks to grow an their full size before they bury themselves in the earth, where they awa transformation. As my Gall-midges did not appear in the perfect state till D and January, it may also with certainty be conjectured that the midges is the earth in spring to propagate their species in the open air. * * * In th of 1832, my first business was to look all round the garden for these midges. the blossom buds of the pear-tree were so far developed that in the single bl petal showed itself between the segments of the calyx, I found the first Gall-n the act of laying its egg in the blossom; this was on the 12th of April. It h itself almost perpendicularly in the middle of a single blossom, and having pie petal through with its long ovipositor, it laid its egg on the anther of the sti blossom. The female was about seven and a half minutes laying her eggs. W had flown away, I cut the pierced bud in two, and found the eggs lying in a l upon another on the anthers. They were white, longish, on one side poin transparent, and from ten to twelve in number. I afterwards found several engaged in laying their eggs, as late as the 18th of April, from which d ceased to appear in the garden. I also saw a Gall-midge on the side of the with its ovipositor inserted in it; so that they do not merely pierce the petals calyx also. I even saw one which, having been somewhat long in laying could not draw out the ovipositor from the blossom; the cause of which I co to be, that the wound had begun to close during the operation and the ovipos thereby jammed in.

It will thus be seen that the habits of the species called *n* very similar to those of the insect from Meriden.

Such descriptions of *nigra* as are at our command seem also icate this species. The only discrepancy occurs in the transl Schmidberger's description,† in which it is stated that the fem

* A Treatise on Insects, &c., by Vincent Kollar, translated by J. and M. th notes by Westwood. London, 1840, pp. 292–295.

† Kollar, l. c. p. 292.

23- to 24-jointed antennæ and the male 11- to 12-jointed. The sexes have evidently been transposed, perhaps in the translation, and the two basal joints not counted. If this be the case, we then have the male antennæ 26-jointed and the female 14-jointed, just as in our species.

In search of evidence as to the identity of the two insects we wrote in March to Dr. Jos. Mik, in Vienna, the well-known Dipterologist, for determined specimens of the European *Cecidomyia nigra*. Dr. Mik replied substantially that *nigra* was not known in collections, and that it is practically a lost species, and advised us to redescribe from fresh material, giving *C. nigra* and *C. pyricola* as possible synonyms.* Under the circumstances, and considering all the evidence *pro* and *con*, we feel little doubt that our species is really the same as *nigra*, but as there seems to have been no careful redescription of this species since Meigen's short characterization, we have drawn up a detailed description of the imago, and have added to it descriptions of the larva and pupa. If dipterologists in future should consider, as Mik does, that *nigra* is really a lost species for want of proper characterization, or if, from future breeding and comparison, the species infesting pears in Europe prove different from ours, then we would propose the name *pyrivora* for that here described, and there can at least be no question as to what insect is intended by this name.

DESCRIPTIVE.

Probably the characters by which the species will be most effectually distinguished are those of the male genitalia, and for this reason we have given an enlarged figure of these parts. There is every reason to believe that in a family in which the species are so small and so uniformly colored, and where the specific differences are so difficult to set forth, we shall find in these genitalia the chief characters for classification in the future. It seems strange, therefore, that so little attention has been given to them by writers on the *Cecidomyidæ*.†

DIPLOSIS NIGRA [?](Meigen).—*Imago*,—♂.—Average length, 2.5^{mm}; expanse, about 5.^{mm}. General color, dark-gray or black. *Head*, with the eyes, deep velvety-black; face dark-gray, almost black, a fringe of long, yellowish hairs, which curve over the eyes, on the edge of the occiput. Antennæ 26-jointed (2 + 24), pedicillate-moniliform, and normally clothed; one-fifth longer than the whole body, black, with the pedun-

*The text of Dr. Mik's letter translated is as follows:

I would send you specimens of *Cecidomyia* (*Diplosis*) *nigra* with great pleasure if I possessed any. I do not believe that a typical specimen can be obtained anywhere, and even if one still exists it would be hardly possible to recognize on account of the perishability of these insects. My opinion, however, is this: How Schmidberger could be led to consider his *Cecidomyia* bred from pears as *nigra*, Meig., I can only explain by its possession of a long ovipositor. This, however, occurs also in other species of *Diplosis*. I do not possess Schmidberger's rare work, but think that he gave no other description of the imago than a repetition of Meigen's description of *nigra*. At least this appears from Nördlinger's "Die kleinen Feinde," 1869, p. 620, as the latter would certainly have repeated Schmidberger's description. *Cecidomyia pyricola*, Nördl. (*l. c.*, p. 622), is also described so poorly that the insect cannot be recognized. It is my opinion that Nördlinger's and Schmidberger's species are identical. [Bergenstamm and Loew express the same opinion in their *Synopsis Cecidomyidarum*, Verh. d. zool.-bot. Ges. Wien, 1876.—C. V. R.] If you will allow me to advise, you should describe your species from fresh and dry specimens as new, and could add the above names as doubtful synonyms. I believe that no error would be committed by adopting this course.

†None of the older authors have paid any detailed attention to them, nor can we find that the parts have been characterized in any but general terms. Josef Mik, in his description of *Cecidomyia hygrophila* (*Wiener Entomologische Zeitung*, Jahrg. ii, 1883, p. 211, Taf. III, Fig. 14) figures and describes the parts in a general way, mentioning the hook and basal portion of the claspers, and two bud-shaped central laminæ, which correspond to the suprapenal plate in our description.

No one probably more fully appreciated the difficulty of separating many of the [illegible] of *Cecidomyidæ* in their mature condition, whether fresh or dry, than our late [illegible]. B. D. Walsh. Yet, though he has so elaborately described many gall-

cles whitish; the two basal joints shortest and stoutest; all others globular, decreasing slightly in size from 3 to 26, the peduncles cylindrical and gradually increasing in length; apical nipple almost as long as apical joint. Palpi faintly dusky, 4-jointed, joint 4 about as long as 2 and 3 together, and somewhat curved. *Thorax* very dark, dull gray or black, with two anteriorly diverging, rather indistinct gray stripes, beset with long yellowish hairs; an oblique row of such hairs runs from near the head and extends along the side of the thorax to near the anterior margin of the scutellum; a semicircle of similar hairs on the scutellum, the lateral ones longest; wings faintly fuliginous, with slight reflections, covered sparsely with a very delicate blackish pubescence; veins somewhat darker; fringes blackish; halteres pale yellowish; legs dusky, with a more or less yellowish tinge; tibiæ palest, femora almost black outside in some of the fully-mature specimens, covered inside with pale-yellow, glistening pubescence, the hairs along the inner surface whitish. *Abdomen* dark-gray, almost black dorsally, where it is sparsely beset with minute, fine, pale hairs, and with a fringe of long, fine, pale-yellowish hairs along the posterior border of each joint; venter more brownish, inclining to black, each joint with a transverse quadrate spot obsolete in the darker specimens, more closely beset with long and somewhat wavy pale hairs; genitalia (Pl. VII, Figs. 3, *b* and 4) pale-yellowish or dusky, consisting of a pair of prominent, 2-jointed claspers or forceps, which, when protruded, are recurved dorsally; the basal joint (*a*) swollen, ellipsoidal, with a few stiff hairs, and very faintly striate transversely; the terminal joint (*b*) consisting of a hook, evidently movable and usually bent inward and backward; just above these prominent claspers is the style or intromittent organ proper (*c*), a pointed process, reaching, when at rest, nearly quite to half the length of the swollen basal joint of claspers, and broadening basally; a suprapenal piece (*d*) is crescent-shaped, the ears of the crescent reaching about as far as the tip of the style, and its base broadening. Still above this is a V-shaped palpigerous piece (*e*), broad terminally, with a well-marked, V-shaped medial slit and with a simple palpus and a stiff hair on either side. The whole mechanism plays on an elastic and membranous sheath, which is retractile within the anal joint of the abdomen. Before use it is closely folded back, so as to be with difficulty analyzed.

♀.—Average length, exclusive of ovipositor, about 3.4^{mm}, the ovipositor, when extended, being longer than the rest of the body; expanse, about 7^{mm}. Antennæ normal, 14-jointed (2 + 12), slightly longer than head and thorax together, the two basal joints as in male; joint 3 longest, almost as long as 4 and 5 together; the rest of about equal length, cylindrical, slightly thickest anteriorly, with rounded tips and somewhat truncated bases; the pedicels of joints 4 to 7 somewhat shorter than the others; apical nipple shorter than apical joint. In general, somewhat lighter color than the male; the extended ovipositor lighter than remainder of the abdomen.

Described from upwards of thirty fresh specimens, reared from larvæ injuring fruit of the pear, at Meriden, Conn.

LARVA.—Length, 4^{mm} to 4.5^{mm}. Color pale yellow. Surface polished and very faintly reticulated. Breastbone pale brownish, its apex broadly bilobed. (In the figure it is represented as rather too long for its width.) Body (13 joints and subjoint) 14-jointed, exclusive of the head. Antennæ 2-jointed. Anal subjoint much narrower laterally than the penultimate, slightly concave, the concavity beset with six (three each side) small fleshy tubercles (the two middle ones are not shown in the figure), of which the second one on each side is stoutest, those on the external angles bearing each a short spine. Spiracles normally placed and mounted on tubercles.

PUPA.—Average length about 3^{mm}. Head, thorax, legs, and wing-cases blackish

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making species, he never refers to the structural character of the genitalia, but dwells chiefly on the far less significant color and the structure of the ovipositor of the female.

Osten Sacken has fully recognized the classificatory value of these genitalia in the *Tipulidæ* (Monographs of the Diptera of North America, Part IV, Smiths. Miscell. Coll., 219, 1869) and admirably figured them. Their value has also been recognized in some groups of Coleoptera (*e. g.*, Kiesenwetter's Monographie der Malthinen, Linnæa Entomologica, xvii, 1852) and in Lepidoptera (see Scudder & Burgess, Proc. Boston Soc. Nat. Hist., xiii, Apr., 1870; F. Buchanan White. Trans. Linn. Soc. Lond., 2d ser. Zool., i, p. 357, 1876; P. H. Gosse, *Ibid*, 2nd ser. Zool., ii, p. 265, 1882), but chiefly in Neuroptera, because of the prominence they have, as a rule, in that Order. Yet no very serious attempt has been made to co-ordinate and homologize the parts. In fact they show in the same Order, and even in the same family and genus, such an infinity of variation that it is questionable whether they can always be homologized. Take as an illustration McLachlan's admirable "Monographic Revision and Synopsis of Trichoptera of the European Fauna." In this he shows how absolutely essential the male genitalia are in discriminating species, though he is often in doubt as to the nature of the parts, or as to what really constitutes the true penis, and with the exception of this organ and its sheath the other appendages are designated either as superior, intermediate, inferior, or lateral. In the Lepidoptera the parts have been variously named so that there is no uniform terminology.

men yellow. Head and thorax together about as long as the two basal joints of abdomen. Front of head conical, acute, having each side, close to the eye, a stout e and two fine hairs dorsally. Another, somewhat curved stout spine arises from upper angle of the wing-cases which reach to the third abdominal joint. Abdo- en quite strongly curved, the sutures rather deep, and containing dorsally a some- hat semicircular, scale-like piece, covered with minute retrorse spines; tip un- rmed and bluntly rounded. Exuvium without special significance, the antennal eaths remaining very much in the normal position.

REPORTS OF AGENTS.

REPORT ON THE LOCUSTS OF THE SAN JOAQUIN VALLEY, CALIFORNIA.*

By D. W. COQUILLETT.

ANAHEIM, LOS ANGELES COUNTY, CALIFORNIA,
September 1, 1885.

SIR: I herewith transmit to you my report upon the Locusts of the San Joa- alley, California.

ccordance with your telegram of the 1st of June, I proceeded to Stockton for the e of interviewing Mr. G. N. Milco, one of the members of the State Horticult- ommission, in order to ascertain from him what part of the San Joaquin Valley st infested with locusts. I learned from him that they were about as numerous vicinity of Merced, in Merced County, as in any other part of the valley, and ited me to pay a visit to the Buhach plantation—of which he is part owner— is situated about 6 miles west of the village of Merced, adding that if I found locality to be a desirable one I would be perfectly welcome to remain at the plan- for as long a time as I desired. A few minutes later I had an interview with proprietor of this plantation, Mr. J. D. Peters, a prominent business man of who, upon learning my mission, also invited me to visit the Buhach planta- emain there as long as I wished. Accordingly I proceeded at once to the lantation, accompanied by Mr. Peters, and finding it to be a very desirable locusts being very abundant, and everything necessary being offered prosecution of my studies—I concluded to make this plantation my head- ers.

y the locusts had almost wholly defoliated several collections of trees and rowing around the residences in this valley, and many alfalfa and grain fields ly swarmed with them.

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* following letter of instructions will indicate the points upon which informa- ion was needed:

DEPARTMENT OF AGRICULTURE,
DIVISION OF ENTOMOLOGY,
Washington, D. C., June 1, 1885.

DEAR SIR: In accordance with my telegram and the inclosed commission, I wish ou to give your time for from six to eight weeks or more, as occasion may require, to thorough examination of the Locust troubles in California. You are doubtless fa- iliar with the work of the United States Entomological Commission on *Caloptenus pretus*, and of course it will not be necessary that you repeat descriptions of any of he remedies there given in detail or illustrated. I wish information as to the amount f damage; as to the range; as to the source and movements both of the young and he winged; the kinds of soil in which they are hatched most abundantly, and every- hing pertaining to their natural history, which will of course be found very similar to hat of *spretus*. Accounts, as far as possible with illustrations, of all particular meas- res adopted that are different from those adopted in the East; observations on enemies nd parasites, and, in fact, as full a statement of the whole subject as will permit you o make a satisfactory report, to be published by the Department.

You should send on specimens properly preserved of the insect in its different stages, ogether with egg-pods, and particularly all parasites and other enemies found attack- ng it. * * *

Yours very truly,

C. V. RILEY,
Entomologist.

W. COQUILLETT,
Anaheim, Cal.

19 AG—'85

About the middle of June the superintendent of the Buhach plantation, Mr. G. E Ladd, who extended me every facility in his power to aid me in studying up the locus problem in this valley, wrote to the superintendent of the Natoma vineyard, near Fol som, in Sacramento County, asking him what remedies he had used for destroying th locusts, and also what success he had had with them, and received a reply stating tha he had been experimenting with a mixture composed of arsenic, sugar, middlings, an water, and was of the opinion that this would prove a decided success.

About this time Messrs. George West and Thomas Minturn, two of the proprietors o the extensive orchard and vineyard of Kohler, West & Minturn, at Minturn Statio in Fresno County, paid a visit to the Natoma vineyard for the purpose of learning mor about the above remedy, and were so much pleased with what they saw of its effec upon the locusts that they determined to try it upon their own orchard and vineyar at Minturn Station, and invited Mr. Ladd and myself to visit them and witness th results of the experiments. Accordingly, on the 24th of June, we proceeded to Min turn Station, and from what we there saw of the effects of this remedy, were con vinced that it was a decided success.

About the 12th of July, Messrs. Milco & Peters sent to the Buhach plantation 1,0(pounds of arsenic, an equal quantity of sugar, and about 3 tons of bran, to be used i poisoning the locusts upon about 300 acres of the plantation that was planted out t fruit trees and grape-vines. Bran has been substituted for the middlings, not onl on account of its being cheaper, but also from the fact that in drying after havin been wet, it forms a jagged mass, which offers the locusts a chance to feed upon it whereas middlings, in drying, being much finer than bran, forms a smooth, eve mass, which gives the locusts no chance to get a bite of it. During the next two d about two-fifths of the above materials were mixed and put out upon the 300 ac mentioned above, and this was repeated about one week later. After the expiratio of a week after this second batch had been put out there were at least 400 dead locus to every living one.

I remained at the Buhach plantation until the first week in August, when, in a cordance with your request for me to return to my home and write my report, I too the train for Anaheim on the 8th of August, and arrived at my destination the nex day. A few days before this I paid a visit to Messrs. Milco & Peters, at Stockto but could not prevail upon them to receive any compensation whatever for my bo &c., while at their plantation. During my stay at the plantation these gen did all in their power to aid me in my studies, and Mr. Milco visited the plan several times while I was staying there, and assisted me much.

To both of these gentlemen, and also to Mr. Ladd, the superintendent, my warme thanks are due. To Dr. P. R. Uhler I am indebte for the determination of seven species of locusts; and last, but by no means leas I am especially indebted to you self for determinations and other help.

Respectfully yours,

D. W. COQUILLETT

Prof. C. V. RILEY,
U. S. Entomologist.

The following pages comprise a report of my observations upon locusts of the San Joaquin Valley, California, during the months of Jun and July, 1885.

I was located at the Buhach plantation, which is situated about miles west of the village of Merced, in Merced County. This plantati consists of about 400 acres, the greater part of which is planted out fruit trees and grape-vines. It is situated in the midst of a great grai growing region, and on every side of it grain fields stretch away almo as far as the eye can reach, dotted here and there by the residences the grain-growers or of their tenants, and by the fruit and ornament trees which usually surround these residences.

When I arrived at this plantation early in the month of June, locusts were already in possession, but they were chiefly found in vicinity of the Lombardy poplar trees which grew along the banks almost every irrigating ditch upon the plantation. Already many these trees were beginning to show evidences of the work of the locust the leaves presenting the appearance of having been riddled by hai stones. Many of the grape-vines growing next to these trees were infested by locusts, which had not only stripped many of them of leaves, but had also gnawed off the buds and tender bark.

The locusts were confined to the trees and grape-vines growing along
e outer edges of the orchards and vineyards, but later in the season
ey gradually spread all over the plantation. They seemed to prefer
e leaves of poplar trees and grape-vines to any others, and were espe-
ally fond of the tender bark of grape-vines. While they would eat
l ves of almost every kind of tree, shrub, and plant growing upon
l itation, yet they manifested an evident preference for certain
The leaves of peach trees were not much relished by them, but
ruit was eagerly eaten, and upon bearing peach trees that had been
l infested by the locusts it was no uncommon sight to see nothing
he leaves and naked pits remaining. Fig and pomegranate trees
ed but little from their attack, as did also gum and evergreen
I saw a small, barrel-shaped cactus which had its inside eaten
oy the locusts.
r ts covered with sacking did not escape the attacks of the locusts,
gnawed holes into the sacking and then entered and devoured
ves of the inclosed plant. One lady sought to save a favorite
t oy turning a washtub over it, but upon removing the tub a few
later she found that the leaves had been entirely stripped from the

l s of alfalfa suffered very severely from the attack of the locusts;
ter were also very destructive to beans, cabbage, and tomatoes,
corn, melon, and pumpkin vines were not much injured by them.
he pyrethrum plants—from the flowers of which the insect powder
wn as "Buhach" is produced—were not much injured by the locusts.
s where the plants had been considerably eaten I found many
sts which acted very much as those do that have been sprayed with
l solution of buhach and water; they had completely lost the use of
legs and were lying upon the ground in a very helpless condition,
ally jerking a leg or moving a foot. Several of them were dead,
l ty having partaken too freely of the leaves of the pyrethrum
ts, as no poison had been put out up to this time.
wh fields, as a rule, were but little injured by the locusts, the
pai injury being done by biting off a small proportion of the heads
allowing them to fall upon the ground. Late-sown wheat suffered
r , and several fields were injured to such an extent that they
harvested.
rye nelds were generally much injured by the locusts, which devoured
exposed kernels in the heads; I have examined many heads of rye
n which every kernel had been devoured. Mr. D. W. Swain estimated
he had lost fully one-third of his crop of rye on 600 acres through
ttacks of locusts. The reason that they were more destructive to
ye than to either wheat or barley is to be found in the fact that the
ernels of wheat and barley are wholly inclosed in a husk, whereas the
ernels of rye are exposed to view.

SPECIES OF LOCUSTS MOST DESTRUCTIVE.

I captured in the San Joaquin Valley no less than twenty different
cies of locusts belonging to the subfamilies *Acridinæ* and *Œdipodinæ*,
principal damage was committed by four species, three of which
ed to the *Acridinæ* or Spine-breasted Locusts.
ecies which appeared in the greatest numbers was the Devas-
Locust (*Melanoplus devastator* Scudder), which outnumbered all
er species combined, in the proportion of at least seven to one.
accompanied by the Ash-colored Locust (*Melanoplus cinereus*

Scudder) which was about one-twentieth as abundant as the former species. These two species were the ones that were the most destructive to the larger fruit and ornamental trees, and they are the only ones that I saw feeding upon the ripe kernels of rye in the fields.

During the hottest part of the day they would sometimes take to their wings and fly to a distance of from 50 to 100 yards at a time. All of them would not start up at once, but one would start up here, another there, and so on, each apparently going entirely independent of the others. When the weather was perfectly calm they would fly in every direction, but whenever there was a gentle breeze blowing they would fly against it; they would not attempt to fly when the wind was blowing hard.

Sometimes when there was a perfect calm one would start up and fly a short distance, when, the breeze starting up, he would turn and fly against it; but when it would begin to blow quite hard he would again turn about and fly with the wind for a short distance and then alight.

In these migrations, if one of the locusts were to fly against a tall tree he would alight there and remain for some time, but if he missed the tree he would continue his flight sometimes until lost to view; at other times he would gradually approach the earth and finally alight, either upon the bare earth or upon any plant, shrub, tree, or other object that chanced to be in his way.

These locusts do not seem to be able to fly in any direction that they may choose, nor to alight in any particular place, alighting as often in the water or upon the bare ground as upon plants. In migrating from the fields to a collection of trees of any kind a very few of them will alight in the trees, but the greater number will drop upon the ground and afterward crawl to a tree and ascend its trunk.

The Ash-colored Locust (*M. cinereus*) flies with greater ease than the Devastating Locust (*M. devastator*). Both species fly in a nearly straight line, and at a distance ranging all the way from 5 to 20 feet from the ground.

These migrations were not always performed for the purpose of obtaining food, as I have frequently seen the locusts start out of poplar trees that as yet had not been much injured by them, of the leaves of which they are very fond. I have also seen them fly out of wheat-fields that had not as yet been harvested, and out of low, waste places that were covered with a rank growth of green weeds.

WHERE DID THESE LOCUSTS HATCH?

As the wind in the San Joaquin valley during the summer season usually blows from the southwest, so the course of the locusts would, in most cases, be directed to the southwest, since they invariably fly against the wind.

Several persons who had visited the foot-hills lying on the east side of this valley early in the season stated to me that the locusts were much more abundant there than they have been in the valley, and that they appeared there much earlier in the season than they did in the valley. These persons were nearly always of the opinion that the locusts which devastated the valley hatched out in the foot-hills, and that as soon as the feed on the foot-hills began to fail, the locusts migrated to the valley; but I arrived too late in the season to definitely settle this question, as the locusts were already very numerous in the valley when I arrived there early in June. I am strongly of the opinion, however, that the greater number of the locusts which ap

this valley the present season were produced from eggs that had en deposited here during the preceding autumn.

As above stated, when I arrived at the Buhach plantation the locusts re most abundant along the outer edges of the orchards and vine-ards, while the more central parts were almost wholly free from them. low, if the locusts had migrated to this plantation, would they not ave been found as often in the center of the orchards and vineyards s along the outer edges? But if the locusts had hatched out upon the lantation we should expect to find them the most numerous in the vi-inity of uncultivated land, where the eggs would not have been dis-urbed by the plow and cultivator; and this was exactly the situation here they were the most numerous—in the vicinity of the uncultivated and along the outer edges of the orchards and vineyards. Had the ggs been deposited last autumn in the more central parts of the or-rds and vineyards, the subsequent cultivating of these would have oyed the eggs, so that no locusts would have hatched out in such ations; and none were found there.

Moreover, I found upon the uncultivated land referred to above quite er of young locusts, which were evidently the young of the De-ting Locust (*M. devastator*), since, in their markings, they approach species more closely than they do any other of the Spine-breasted s which inhabit the San Joaquin Valley. The following is a de-ption of these young locusts, drawn from fresh specimens:

Head, ashen-gray, whitish below each eye. Thorax, ashen-brown; two dark-brown subdorsal stripes, one on each side, and below each is a whitish line, then a dark bordered below by a whitish line. Abdomen, ashen-pink, mottled with dark own. Venter, whitish, unmarked. Legs, ashen-yellow; hind femora with a longi- black stripe on the outer side, interrupted at the middle of the femur and sub-upted at the first one-fourth; upper side of hind femora marked with three ack spots, the first at one-fifth, the second at two-fifths, and the third at two-thirds he length of each hind femur from its base, the first spot sometimes wanting, the econd and third spots extending slightly upon the inner side of each hind femur efore the tip. There is a blunt spine between the front legs.

In all of these characters the agreement with the adult Devastating Locust is very close. There are only three species of Spine-breasted Locusts inhabiting the San Joaquin Valley which approach this species very closely in their markings; and from each of these both the adult Devastating Locust and the young locusts above described differ as ows:

Melanoplus cinereus Scudder (the Ash-colored Locust), has no black pots on the hind femora.

Melanoplus sp. (probably only a variety of *devastator*) has no distinct k subdorsal stripes on the thorax.

Paroxya sp. (near *atlantica* Scudd.) has the subdorsal stripes of the rax well defined, not interrupted, and of nearly the same width hout their entire length, while in the adult Devastating Locust ne young ones above described these stripes taper posteriorly, are well defined, and are generally interrupted.

These young ones quite closely resemble those of the Differential Lo- (*Caloptenus differentialis* Thomas), but differ in having no black on the groove on the under side of each hind femur.

ems quite evident, therefore, that the young locusts above de- those of the Devastating Locust, the species which committed extensive depredations in the San Joaquin Valley the present and if they were the young of that species, then the latter in the San Joaquin Valley, since it would have been quite im- these young ones—many of which were not more than one-

fourth grown—to have found their way to the Buhach plantation from the foot-hills, a distance of from 15 to 20 miles.

When I first arrived in the valley, the Devastating and Ash-colored Locusts were most numerous in those grain fields that had not been plowed for a year or more, that is, in fields of what is commonly called "volunteer" grain, *i. e.*, self-seeded. Some of the locusts remained in these fields for two weeks after the grain had been harvested; by the latter part of July scarcely a single specimen of either the Devastating Locust or the Ash-colored Locust could be found in these fields, but t low waste places, which were quite numerous in and near all of the g fields, and which were covered with a rank growth of green weeds, v infested with immense numbers of these locusts, which doubtless wil breed in these situations.

These waste places are covered with water during the latter part of the winter season, and sometimes until late in the summer. When the proper time for putting in the seed arrives they are too wet to be plowed and seeded, and are therefore allowed to remain undisturbed from year to year. The green weeds which these waste places contain late in the season, when the surrounding fields contain nothing green, furnish food to the locusts until their egg-laying season arrives, when they will doubtless deposit their eggs in these waste places; and as these eggs do not hatch until the following spring, they must be covered with water for a period of two or three months. This would not necessarily destroy their vitality unless they were covered by the water for too long a time, since Professor Riley has ascertained that the eggs of the Rocky Mountain Locust (*Caloptenus spretus*, Uhler) were not affected by being submerged in water for three months during the winter and early spring.*

CAUSE OF THE ABUNDANCE OF THE DEVASTATING LOCUST IN THE SAN JOAQUIN VALLEY DURING THE SUMMER OF 1885.

If, as we have supposed above and have every reason to believe to be a fact, the Devastating Locusts deposit their eggs in these waste places, we see that in ordinary seasons these locusts will not appear in sufficient numbers to attract attention, since the water will be removed, by evaporation or otherwise, from the more elevated portions of these waste places first, and therefore the eggs which have been deposited in those elevated places will be the first to hatch out, followed by those that had been deposited in less elevated places, and so on. It follows that those hatched out the earliest will be the first to acquire wings and migrate to the adjacent fields, followed after a certain time by those hatched out next, and so on. By coming into the fields so gradually and spreading over so large an area of land, their presence will scarcely be noticed. It is also quite certain that many of the eggs are destroyed by being too long covered by the water, since, in ordinary seasons, several of these waste places contain water until quite late in the summer.

Thus it happens that in ordinary seasons the locusts never appear in sufficient numbers to attract attention.

Last winter, however, but little rain fell, and, as a natural consequence, what little water was collected in the waste places soon evaporated, leaving these places perfectly dry for some time before the time for the locust eggs to hatch out had arrived; consequently, when the time for these eggs to hatch out did arrive, they all hatched out within a short time of each other, and as they would all acquire wings and mi-

* See the First Annual Report of the U. S. Entomological Commission, pp. 359, 360.

to the adjacent fields nearly at the same time, their coming all at , or within a short time of each other, would very naturally attract n. Moreover, it is very evident that they appeared in greater im s the present season than they do in ordinary seasons, since none eggs were destroyed by being covered with water for too long time.

As stated above, the locusts left the grain fields this season a few eeks after the latter had been harvested, there being no green food r them to obtain in these fields; but it is quite probable that, as last ason was a very wet one, there may have been green weeds in the rain fields as late in the season as the locusts deposit their eggs, and such was in reality the case, then we may suppose that many of the sts deposited their eggs in the fields last autumn. This would ac- for the fact that the locusts were most numerous the present n on those fields which had not been plowed for over one year.

From the above facts it would appear that whenever there is a very ry winter and spring in the San Joaquin Valley there will be an abun- lance of locusts in that valley during the following summer; but when here is an abundance of rain during the winter and spring months here will not be an unusual number of locusts during the following summer.

In the latter part of July I saw several pairs of the Ash-colored Locust (*M. cinereus*) united in coition, but up to the time that I left this valley—the first week in August—I did not see a single pair of the Devastating Locust thus united.

THE DIFFERENTIAL LOCUST.

The Differential Locust (*Caloptenus differentialis* Thomas) was only about one twenty-fifth as numerous as the Devastating Locust. These two species and the Ash-colored Locust were the only Spine-breasted Locusts that appeared in destructive numbers in the San Joaquin Valley the present season. The only other species of Spine-breasted Locusts that I took in that valley are the *Acridium shoshone* Thomas; the *Hesperotettix viridis* (Thomas), and the *Paroxya* (near *atlantica* Sc.).

When I first came to this valley, early in June, the Differential Locust was mostly in the wingless state, there being only about one winged specimen to ten wingless ones; by the last week in July the greater number of them had acquired wings. On the 23d of June I saw the first pair united in coition, but the majority of them did not pair until about three weeks later. After coition, and before the eggs are deposited, the abdomen of the female increases very much in size.

The first egg-mass which I saw this species deposit was deposited on the 23d of July. The location chosen was a shaded place on the north side of a row of trees and in a sandy soil. A basin-like hole had been dug in the ground at the base of an ornamental tree, and had been filled with water a day or so previously, for the purpose of irrigating the tree. The female locust had worked her abdomen into the ground on the outer edge of this basin. I first discovered her in this position at about 3 o'clock in the afternoon, and at 15 minutes past 4 o'clock she had com- ed depositing an egg-mass and walked away.

s egg mass is about three-fourths of an inch long, slightly curved, a little less in diameter than an ordinary lead pencil. The space the uppermost eggs and the surface of the surrounding earth in with a frothy matter. When freshly deposited the eggs of a pale bluish color.

On several succeeding days I saw many females of this specie their eggs, and in nearly every instance the situation chosen purpose was the edge of one of the basin-like hollows at the tree.

I saw several of the females make numerous attempts to s abdomens into the earth upon a hard beaten walk, but always meeting with success. They do not appear to have the power trate hard substances that is possessed by some locusts. Upon casion I saw a female *Chloëaltis conspersa* (Harris), that had e a hole in the bark of a burr-oak log by means of the horny pla tip of her abdomen; when found by me she had reached a depth about one-half the length of her abdomen. This occurred in Illinois.

The Differential Locust is not so easily startled as the Dev Locust is, and its flight is heavier and sustained for only a short seldom flying more than 12 or 14 feet at a time. It does not those migrations indulged in by the Devastating and Ash-col custs, seldom taking to its wings except when disturbed.

It was principally found in trees, being especially partial to tl of poplar trees. I did not find it in the grain fields, and it only in limited numbers in the low, waste places, overgrown wit It was very numerous in alfalfa fields, where it probably breeds, ones of all sizes were very numerous in these fields.

THE YELLOW LOCUST.

The only species of Spineless-breasted Locusts (*Œdipodinæ*) peared in destructive numbers in the San Joaquin Valley the season was the Yellow Locust (*Trimerotropis pseudofasciata* S which was only about one-twentieth as abundant as the Dev Locust. When I first came to the valley early in June, this spe most numerous in grain fields, but after these had been har migrated to new pastures. In many places it was very destr the leaves of grape-vines and low trees, but it was very seldo in large trees.

The flight of the Yellow Locust is more undulating than th Devastating Locust, and is sometimes continued for long dista time. They do not always fly in one direction, against the win last-named species almost invariably does, but fly in almost eve tion. They do not all start at once, but one will start up here, there, and so on, each apparently going entirely independen others.

Their flight is sometimes accompanied by a crackling sound, appear to produce this sound at their pleasure while on the win eral other species of Spineless-breasted Locusts (*Œdipodinæ*) produce this sound while on the wing, but I am not acquainte single species of Spine-breasted Locust (*Acridinæ*) that ever pr similar sound.

The Yellow Locusts are more frequently found resting upon ground than in any other situation, but during the hottest pa lay they seek the shade of low weeds, grape-vines, small t which they usually ascend, but never, or very seldom, go very have frequently seen them feed upon dry leaves, and they see er feeding upon these on the ground to climbing after the gre

I have also seen them feed upon a locust that had but recen a by would usually begin upon the side of the thorax next to t

away the whole side and internal parts of the thorax, sometimes ouring the greater part of the abdomen. This cannibalistic ems to be indulged in by all the different species of locusts that this valley.

several pairs of Yellow Locusts united in coition in the latter June, but did not succeed in obtaining any eggs, although I fre- saw a female that had her abdomen sunken its whole length loose sand in the grain fields; after she had withdrawn her and walked away, I carefully dug up the earth in the place er abdomen had been thrust into the sand, but never succeeded ning the eggs. As the situation chosen by these females was pen fields where it was impossible to watch their movements ved by them, it is quite likely that my presence frightened or se disturbed them to such an extent that they would not deposit gs so long as I was within view of them. So long as I remained from view, the female Differential Locust would continue deposit- eggs, that is, when I discovered her in the act of depositing ne distance off, and my presence was unknown to her; but, when ıpon her unawares and she saw me, it mattered not how quickly efully I withdrew myself from her sight, she always refused to any eggs, after a certain time withdrawing her abdomen and away. Hence I believe that no female locust will deposit her ıen she is aware of the presence of any person.

OTHER SPECIES OF LOCUSTS.

ured eighteen different species of locusts in the San Joaquin luring the two months that I remained in that valley. In order the comparative abundance of each of these species, I sub- with a list of those determined, with numbers attached show- numbers in which the locusts of each species appeared as com- ith those of any of the other species. Thus, the first species is ıted by the number 1 and the second species by the number 4, ıg that there were four specimens of the latter species to every he former, and so on throughout the list:

lexana Scudder	1
tix viridis Thomas	4
allula Scudder	6
ellucida Scudder	8
hoshone Thomas	10
venusta Stål	10
pis vinculata Scudder	20
pis sp.?	40
pis sp.?	50
s probable var. of *devastator*	50
ear *atlantica*	50
pis sp.?	75
spurcata Saussure	100
differentialis Thomas	750
s cinereus Scudder	1,000
vis pseudofasciata Scudder	1,000
devastator Scudder	20,000

INJURY COMMITTED BY THE LOCUSTS.

difficult to give any idea of the injury committed by the San Joaquin Valley the present season. A majority of grape-vines that had been defoliated by them, put forth h of leaves in the course of three or four weeks from the

buds that ordinarily would not have developed until t lowi
son; in these cases the only injury sustained through t attacks
locusts was a partial arrest of the growth of the trees d v
in many cases a loss of the fruit upon fruit-trees g vi
bearing.

Grape-vines that had been stripped of their leaves, bu and
of their bark, sent out new shoots from the base of the vin
nuded part dying back as far as the buds and bark had been r
In cases where the bark had been removed but the buds had not
injured, these buds developed a new set of leaves, and a new
seemed to be forming in those places where the old bark had be
moved.

Several vineyardists plowed under their young vines to save
from receiving further injury from the attacks of the locusts, an
to prevent them from drying out, and the majority of the vines t
in this manner, in the course of three or four weeks, sent up
growth through the thin covering of earth that had been thrown
them by the plow.

The devastations committed by the locusts in the grain fiel
vegetable gardens were in most cases irreparable. Alfalfa
in most cases kept eaten down so closely by the locusts that not
gle crop of hay was gathered from them.

NATURAL ENEMIES.

Besides several kinds of domestic animals, such as hogs, dogs
chickens, ducks, turkeys, &c., I have also seen several kinds of wil
mals, birds, and insects preying upon the locusts. Among these is a
ground-lizard, or *scift*, as it is commonly called, which I have
seen catch a locust in its mouth, springing upon it somewhat as
would spring upon a mouse. I have also seen the following birds
ing upon locusts: Bullock's oriole (*Icterus bullockii*), a sparrow r
bling the Eastern Song sparrow (*Melospiza melodia*), and a larger
row having a patch of red feathers on the head.

Among insects I saw two different species of wasps preying upo
locusts. The most common species is the *Prionony x atrata*. W
locust takes to its wings one of these wasps will pounce upon it,
it in her legs and bear it to the ground, after which she thrust
sting into it; the part of the locust into which the sting is thrust
under side of the thorax, between the insertion of the first two pa
legs. Soon after being stung the locust becomes motionless, whe
wasp gets astride of it, seizes its antennæ with her jaws, and drag
locust to her burrow, the body of the locust being under and dir
in the same direction as that of its captor, three of the wasp's leg
ing on one side of the locust and three on the other. The wasp l
the locust at short intervals for the purpose of finding her burrow
which she returns to it again and drags it a short distance farth
the direction of her burrow.

I have seen upwards of two dozen of these wasps thus draggi
custs to their burrows, which are always made in loose, sandy soi
in every instance the victim was a Devastating Locust. How and
they always select this species for their victims is a mystery, since
were always three or four other species of locusts of the same siz
nearly of the same color—among which may be mentioned the
colored Locust—always associated with them; still I never saw
attacking any other species than the Devastating Locust.

After dragging the locust into her burrow the wasp stations h

front of the latter, her head directed from it, and then with her front
t she throws the dirt into her burrow, occasionally going into the lat-
r apparently for the purpose of scratching the dirt into the farthest
. of it, soon to return and resume the filling-up process; in this way
e continues until the burrow is filled up and not a trace of its existence
to be seen.

In digging her burrow the wasp frequently uses her strong jaws, but
filling it up she uses her feet almost altogether, standing upon her
vo hind pairs of feet and scratching with her front ones somewhat as
d would; all of her movements are very rapid.

I r a single specimen of another species of wasp dragging a De-
ming Locust to her burrow; she dragged the locust into her burrow
ne manner that the *Priononyx atrata* did, as described above.
I o r a single specimen of the *Sphex rufiventris* dragging a wing-
eri et (*Anabrus* sp.) to her burrow in a similar manner. During
iore part of July I saw several pairs of these *Sphex* wasps united
n tion in the dooryard of the Buhach plantation, while many of them
were lying upon the ground dead; these latter I judged were males
which had died after coition had taken place.

On the 20th of July I found three red mites attached to the under side
of the breast of a *Trimerotropis* sp., a Spineless-breasted Locust having
the hind wings bluish at the base. These mites were in shape like an
erted tea-cup, and were doubtless the young *Trombidium locustarum*;
unfortunately they escaped before a careful examination of them
l be made, and I did not succeed in obtaining any additional speci-
mens.

On the 6th of July a dipterous larva, about 9 millimeters long, issued
rom an oval hole in the side of the thorax next the head of a *Disso-
teira spurcata* which I had inclosed in my cyanide bottle; this larva
lied before pupating, having been killed by the cyanide, as it was not
iscovered by me until an hour or more had elapsed after I placed the
ocust in the bottle.

This was the only specimen of this parasite that I obtained, although
dissected many hundred locusts in search of additional specimens,
ut without meeting with success.

In a paper on the North American *Conopidæ*, which appeared in the
tions of the Connecticut Academy of Natural Sciences, for the
n of March, 1885 (vol. vi, p. 389), Dr. S. W. Williston, quoting
Brauer, states that *Conops* is sometimes parasitic upon *Œdipoda*
genus of Spineless-breasted Locusts). The only species of *Conops*
t I have taken in the San Joaquin Valley is the *Physocephala affinis*,
Villiston; and the Dipterous larva mentioned above may have belonged
o this species.

REMEDIES.

As soon as the locusts began to appear in destructive numbers upon
ie Buhach plantation, the superintendent, Mr. G. E. Ladd, tried a great
y means of destroying them.

Adjoining this plantation on the west is an alfalfa field that literally
ned with locusts; many of them found their way to the adjacent
upon the Buhach plantation, and to intercept them Mr. Ladd
a windrow of dry pyrethrum stems between this alfalfa field and
row of trees upon the plantation. In the evening many of
us would crawl into this windrow for the purpose of spending
nt therein, and late at night the windrow was set on fire; in this

way a great many of the locusts were destroyed, but a great many mor passed over the windrow into the adjacent trees.

This alfalfa field was rolled late in the evening with a heavy woode roller, but this did not kill very many of the locusts, although th ground was quite level, but sandy. I have repeatedly stepped squarel upon a locust on loose, sandy soil, without injuring the locust in th slightest degree, so far as I could discover.

A small patch of alfalfa that was thickly infested with locusts v sprayed with a solution composed of 1 part of the kerosene emulsion (gallons kerosene, 1 gallon water, and one-half pound of soap) dilute with 4 parts of water, but the locusts were not killed by it. Locust immersed in the undiluted emulsion died a few minutes afterwards.

Mr. G. N. Milco, one of the proprietors of the Buhach plantation, trie the experiment of driving the locusts out of a small vegetable garden b burning some flowers of sulphur on the windward side of the garden the locusts were not visibly affected by it. Several other perso tried this remedy, but always with a like result.

This remedy might prove effectual in localities where the air is s damp and heavy as to keep the smoke near the ground, but in a climat where the air is so light as it is in the San Joaquin Valley in the mer time it will avail nothing, as the smoke rises rapidly in the air an thus is not brought in contact with the locusts upon the surroun vegetation.

Mr. Frank Smith, whose farm adjoins the Buhach plantation on th west, had a trough of zinc constructed, the dimensions of which w about as follows: Length, 6 feet; width, 2 feet; depth, 18 inches. Th was mounted on runners, and late in the evening it was drawn by horse through the orchard; the bottom of the trough was covered to th depth of 5 or 6 inches with strong soap-suds.

In operating it, the trough was drawn beneath a tree infested wi locusts; the tree was then struck with a heavy stick that had wrapped in several thicknesses of cloth to prevent bruising the tre by this operation many of the locusts were dislodged from the tree an fell into the soap-suds in the trough, and after a certain quantity them had been thus collected they were transferred into grain-sacks afterwards beaten to death with a heavy club. In this manner a gre many of the locusts were destroyed.

This plan would have been more effectual had there been two trou instead of only one, so that there could have been a trough placed (each side of the tree. The best results were obtained when it v operated very late at night, when the locusts were somewhat stupe by the cold.

A remedy that has been very successful in destroying locusts consis of a certain proportion of bran, arsenic, sugar, and water; these ha been used in different proportions, but the one that appears to give best results consists of 1 part by weight of arsenic, 1 of sugar, and b bran, to which is added a sufficient quantity of water to make a w mash.

This preparation is usually prepared in wash-tubs or half-barre One of these is filled about three-fourths full of dry bran, and to this added about 5 pounds of arsenic, which is thoroughly stirred thro the bran with a spade or shovel. Five pounds of sugar is next throw nto a pail, which is then filled with water and the sugar stirred un t is dissolved, when this sugar-water is added to the bran and a nd the three well stirred; more water is added and the stirring c ir ed until every portion of the mash becomes thoroughly satu

it a teaspoonful of this mash is placed at the root of each tree, or plant infested with locusts, dropping it in the shade when this done. In the case of low shrubs or plants nothing more need be s the locusts will find their way to the poison, but when large e treated the locusts should be jarred out of them, or be driven h long poles.

e known locusts to be killed by eating some of this mash that n put out over a week previously. The poison works very slowly, en put out early in the morning will show but little effect upon usts until quite late in the day. A Devastating Locust that I ting the mash at 9 o'clock in the forenoon was still alive at 6 in ning, but was dead when next examined early the next morning. ving a teaspoonful of this mash to each grape-vine in the vine- the vines being 7 or 8 feet apart—this will require about 10 of the dry bran (and arsenic and sugar in proportion) to each The cost of the material will vary, but should not exceed 50 cents h acre of grape-vines, including cost of labor for mixing and ap- it. For orchards the cost will be much less than this.

addition of sugar to this mash is merely for the purpose of caus- arsenic to adhere to the particles of bran, and not for the pur- increasing its attractiveness, since bran is more attractive to the than sugar. This I have demonstrated to my own satisfaction. ntity of sugar was placed upon the ground contiguous to an equal y of bran mash; when a locust came to the sugar he would eat a f it, move on a short distance and again take a few bites of the and continue in this manner until he reached the mash, when he settle down, eat his fill, and then move off. The locusts which the mash before reaching the sugar would, almost without ex- , eat their fill of the mash and then walk away, but occasionally uld leave the mash and take a few bites of the sugar, only to re- the mash again. None of them ate their fill of the sugar, but manifested an evident preference for the mash.

mash was used upon about 300 acres of orchard and vineyard on hach plantation, and about two weeks later scarcely a living was to be seen where they could have been counted by the hun- even thousands before the poison had been applied, the ground y places being literally covered with the dead bodies of the slain. ral other parties also used this poisonous mash, and so far as I le to learn, it gave entire satisfaction in every instance.

xercising only ordinary precautions there need be no fear of en- ing the lives of either man or any of the domestic animals in using isonous preparation. It should be mixed in a close room to pre- e arsenic from being blown about by the wind. There is no need hing the arsenic or the mixture with the hands, as the mixing tributing is accomplished by means of spades, shovels, wooden , &c.

urse this mixture should not be put out in places where poultry of the domestic animals can gain access to it. Upon the Buhach ion were four greyhounds and several cats that were allowed to bout the plantation where this mixture had been put out for the still at the time that I left the plantation—about four weeks poisonous mixture had been put out—not one of them had either by eating of the mixture itself, or of the locusts that ned by it.

re also several barnyard fowls upon this plantation, but not was poisoned from having eaten locusts that may have

found their way to the poultry range after having eaten of the poisonous mixture. Mr. Boynton, whose farm adjoins the Buhach plantation on the west, stated to me that many of the locusts which had eaten of the poisonous mixture would fall into an irrigating ditch that flowed through his poultry yard, and many of the locusts were thus carried within the reach of his fowls; still he was not aware that any of the latter had died from the effects of having eaten of the poisoned locusts.

In fact, I did not learn of a single instance where this mixture had caused the death of any person, nor of any domestic animal, although it was used very extensively in many parts of the San Joaquin Valley. Neither were the birds killed in any considerable numbers from having eaten either of the mixture itself or of the locusts that had been poisoned by it. During the four weeks following the putting out of this mixture upon about 300 acres of the Buhach plantation, I found only about half a dozen dead birds that had evidently met their death through the agency of this mixture; these consisted of three or four meadow larks, a bee-bird, and a field sparrow.

Rabbits and hares, or "jack-rabbits," as they are commonly called, were destroyed in large numbers by this mixture. After the greater numbers of locusts upon the Buhach plantation had been destroyed the work of extermination was carried into a large patch of wild sunflowers adjoining the plantation on the north, and as one of the results, at least two dozen hares paid the penalty with their lives.

The four greyhounds belonging to the plantation were among these poisoned hares almost every day; still I never saw one of them attempt to feed upon the poisoned hares; certain it is that not one of them met his death from this cause.

As the mixture is saturated with water before it is put among the plants infested with locusts, there is no danger of its being blown about by the wind; and there is also very little danger of its being deposited upon the fruit by the feet of birds and insects that may have alighted upon the mixture and afterwards flown to and alighted upon the fruit. As the mixture becomes dry its particles adhere together, forming a solid mass which could not be blown about by the wind.

I have never seen this poisonous mixture used in grain fields, but know of no reason why it would not prove very effectual in such fields. Great care should be exercised in using it in alfalfa fields, but if it were placed upon small pieces of boards it could doubtless be used with entire safety in such fields; but of course it would not be safe to pasture any animal in such fields, even after the poison had been removed.

Where it is desired to destroy locusts infesting trees or shrubs in places where it would not be safe to use the poisonous mixture described above, this can be accomplished by placing blankets upon the ground beneath the tree or shrub and spraying the latter with a solution composed of 1 pound of buhach thoroughly stirred in 10 gallons of water. This solution will be more effectual if 2 or 3 pounds of glucose is added to it, first dissolving the glucose in hot water; the addition of the glucose is for the purpose of causing the solution to adhere more firmly to the bodies of the locusts, while its presence does not appear to have injurious effect upon the leaves of such trees as the Carolina Pop

The best time for applying this solution is late at night, and the stiller the night the more effect the solution will have upon the locusts. In a few minutes after it is applied the locusts will begin to drop down upon the blanket placed under the tree, and in the course of half an hour all of the locusts that have been touched by the solution will be lying upon the blanket in a perfectly helpless condition, when they can easily be

One way of accomplishing this is to gather the locusts in a
ɔv the latter with straw and then set fire to it; or they may be
in grain sacks and immersed in scalding-hot water until life
nct, after which they may be fed to hogs or to poultry.
of the best nozzles that I have ever used for spraying this solu-
the "Cyclone" nozzle, originally introduced by the Department
riculture. It throws a very fine spray, and by its use the upper
l as the under surface of the leaves can be directly sprayed—an
that could not be attained in using the old "San José" nozzle,
threw a spray from its *end* instead of from one of its *sides*.

RT ON THE ABUNDANCE OF THE ROCKY MOUNTAIN LOCUST IN 1885.

By LAWRENCE BRUNER, *Special Agent.*

WEST POINT, NEBR., *August* 20, 1885.

Herewith is submitted a report of my recent visit to the valley of the Lower
stone River of Eastern Montana and the adjoining portions of Northwest Da-
where it was reported the "grasshopper" or Migratory Locust (*Melanoplus*
) had appeared in injurious numbers.
trip was taken under your direction for the purpose of ascertaining the truth-
of these reports, and if possible to predict for the future.
ill be seen by the accompanying notes, I first visited Glendive, Mont., from
point I worked down the Yellowstone Valley to its junction with that of the
ri at Fort Buford. From here, along the latter, to Bismarck, and thence across
y to Harold, on the Dakota Central branch of the Chicago and Northwestern
ıd.

Very respectfully,

LAWRENCE BRUNER.

C. V. RILEY,
United States Entomologist, Washington, D. C.

first Rocky Mountain Locusts observed on this trip were seen to-
July 29) at a point about 80 miles east of Glendive, Mont. They
quite numerous and were observed, as the train sped by, to hop
from the side of the railroad track where they appeared to have
egated for the purpose of feeding upon the rank vegetation which
upon the loosened soil of the road-bed.
on going out in the streets of Glendive, on the morning of the
instant, I observed large numbers of several species of locusts
the ground and among the scant herbage. Some of these, about
were of the migratory kind and appeared in excellent health.
emaining half was composed of the Lesser Locust (*Melanoplus at-*
, the Red-thighed Locust (*M. femur-rubrum*) and other native
By making inquiries I ascertained that elsewhere they were
ıy numerous and at some places far more numerous even than
were there.
e peculiarity which I noticed in connection with the locust visita-
here this season is the presence of every other species of locust
n to occur in this region in equally large numbers with the de-
tive species (that is, as the term "destructive species" is generally
ɔd). Even species which have hitherto been considered as rare
points in the West are this year present in comparatively large
as, for example, *Boöpedon nubilum*, *Melanoplus infantilis* and
pulchella (the latter an undescribed species, which is only

known to occur in the Yellowstone Valley, where it feeds exclusively upon the white sage, *Eurotia lanata*).

In visiting the regions about the neighborhood of Glendive, I found the locusts equally numerous on the lowlands and highlands, as well as on the hill-sides.

The various species of *Melanoplus* falling in the same group with *spretus* and *atlanis* are more partial to localities where the vegetation is somewhat rank, and consequently tenderer than the growths upon the higher slopes and plateaus, than they are to the more elevated and open tracts where the grasses and herbage are short and rather dry. Through inquiries it was ascertained that locusts of all kinds are equally numerous up the valley to the mouth of Powder River, or perhaps even to that of the Tongue River at Miles City. So persistent and numer are they at O'Fallan's Creek that they have almost denuded the ranges of grass, and the cattlemen of that neighborhood contemplate mov their stock to adjacent ranges for feed. This wholesale destruction o the bunch and buffalo grasses is mainly due to the work of "natives" rather than to the Migratory and Lesser Locust. In fact the grass over a considerable portion of Northwestern Dakota and Eastern Montana is greatly damaged and in many places entirely eaten away. To be more explicit, the region embraces in Montana between the Missouri and Yellowstone Rivers to about the one hundred and eighth meridian, and the adjacent part of Dakota to about the one hundred and second meridian. As a proof of the great destruction in this direction, we need but state that the surface of the ground throughout all parts of this area is strewn with the small elongate pellets of their excrement, which in some places entirely cover the ground, and in others, where the rains have washed them together in heaps, a half of an inch or more in depth.

The locusts have also been quite destructive to gardens and fields of small grain at various points along the Yellowstone River betw Glendive and Fort Buford; also at Wolf Point and Poplar River Agency, while a little injury was also occasioned by them on the Little Muddy and at Grinell's—the former 22 and the latter 65 miles below Fort Buford on the Missouri. This injury to vegetables and grain was done chiefly by *M. spretus*, *M. atlanis*, and *Camnula pellucida*, while the injury to the grasses can be attributed mainly to the other species common to the region.

During the time which was spent in this region locusts were se the air at different localities and intervals wherever I happened to b when the wind was blowing from some point in the north (including al directions between east and west); but at no time were their flight very extensive or the numbers seen great. As near as I could learn b inquiry at various points along the line of my travels, there were few flights prior to July 29, on which date they were first observed the air at Glendive, at which time they were moving in an easterly southeasterly direction. This was also the day when I observed species—probably the advance guard of those which left the regio about Glendive in the forenoon.

As will be seen by reference to the notes of the trip, which are t scribed and sent herewith, locusts were observed in the air at va points within and adjoining the district mapped out, all of which, wi but a single exception (when they moved southwest), were moving sou ward and eastward; so it will not appear at all strange when it is le that they have spread over all the region in Dakota as far south as Big Cheyenne River and as far east as the James River. This scatte ing has all occurred within the past three weeks, and that, too, wl the prevailing winds were contrary. This course is liable to be con

from now on until into the middle of September, when localities ch more widely removed from the breeding center will be reached. Up to the time of my leaving the locust area indicated no eggs had been deposited by the Rocky Mountain species, that I heard of, but cimens were seen in coitu at all points where the species were ob- ved after August 1. From this fact as a basis it will be safe to pre- t a general deposition of eggs over the entire area visited and still o visited by the advancing flights. By referring to the records for years in the United States Signal Office at Bismarck, Dak., it was tained that the prevailing wind in that region changes from the and southeast to the northwest about the middle of August; and consequence from this time on we may expect more northwest winds we have thus far had since the locusts began their southward nts, and as a natural result a continuation of this movement is e anticipated. Now, it depends altogether upon the weather and of winds henceforth this season whether or not any of these are so to mass the locusts at some particular locality, and thereby it in damage to the corn crop.

The probabilities now are that *M. spretus* will hatch in moderate numbers throughout the region this year overrun, and, in addition, throughout the greater part of Dakota, as well as parts of Northern Nebraska and Northwest Iowa. Of course, when they have been spread over so extended an area, there can but little harm emanate from the comparatively small swarm which produced them. The only chance now of injury from locust swarms next year is in the possible accumulation of numbers during the present fall, while they are still moving, and before the majority of their eggs have been deposited, or in a like accumulation over the young of next year's hatching have become fledged and begun their flights. Such a state of affairs can only come to pass by the aid of extremely favorable circumstances, and when we take into consideration the numerous adverse agencies which in ordinary years combine to promote the highest possible development of the species we need not fear any such calamity. The chances for such an increase are diminished at least one-fourth by the fact of the summer thus having been a rather exceptionally humid one, and the chances are that the fall will continue similarly wet, which, if followed by an open winter will have the same effect upon the hatching of the eggs as did that of 1876–'77.

A fact particularly noticed this year is the comparatively few parasites of every species that are known to destroy this and other locusts. While in Montana and Dakota I became interested in no small degree in noting the almost total absence of certain parasites which had been found in the same localities several years ago in rather large numbers. I therefore took particular pains to watch for these beneficial insects, and as a result of these observations, I am sorry to say there is but little need of looking to this quarter for aid in checking the already rapidly advancing increase of locusts in Montana and Northwest Dakota the coming summer. This scarcity of these natural aids of man in this direction can be attributed to no other cause than the locust invasions of 1882, 1883, and 1884 in this particular region, in connection with the absence of the Rocky Mountain Locust from the greater portion of the country since 1878. All these parasites appear to thrive best, and many of them, on account of their delicate structure, entirely dependent for their development upon a considerable amount of moisture. The present wet summer may, however, have a tendency to increase their numbers again.

One feature of this year's storms in the valley of the Yellowstone and Missouri Rivers was the great amount of large hailstones which fell and destroyed many locusts. Some of these hail-storms were so severe that for several days after they had occurred dead locusts by the hundreds were to be found upon the prairies. These storms were also injurious to crops—far more so than the locusts would have been that were killed by them. The great amount of rain which fell, on the other hand, was the means of producing a greatly-increased crop of grasses upon the prairies, which otherwise must have been almost entirely devoured.

Next to the Rocky Mountain Locust the species most to be feared in this region is the Lesser Locust, *Melanoplus atlanis*, Riley, which in many places was seen in numbers fully twice as great as the former. The species here differs from the typical specimens of the East in the color of the posterior tibiæ. Those of the East invariably have these members reddish, while most of those occurring here have them greenish-blue. The Northwestern specimens are also somewhat larger and have a brighter, healthier appearance than do those of their Eastern kindred. Otherwise there appears to be no difference in the species as found in the two widely-separated districts. This species, although congregating in great numbers at various points, was not observed to accompany *M. spretus* in its flights; neither was it noticed to migrate separately by flight. The species in its habits is quite similar to that of *M. spretus* in many respects, while in others it differs from those of that insect. For example, it seldom, if ever, deserts tracts of rank or succulent vegetation for the higher, comparatively barren hill-tops, as does *spretus* at times, neither does it choose open localities for the deposition of its eggs, but prefers to hide them among the grasses on rather moist than dry ground, in this respect imitating the habits of *M. femur-rubrum* and *M. bivittata*.

Camnula pellucida (*Œdipoda atrox*), one of the destructive Califo species, has also become a very numerous species in the valley of Yellowstone and Upper Missouri Rivers, and if it continue to inc and spread as rapidly during the next five years as it has during past five years, it will also become a plague on the eastern sl the Rocky Mountains, as it has been in times past on the Pacific Three years ago the species was first seen by me in the valley o Yellowstone at Livingston, and two years previous in the valley of Gallatin, Madison, Jefferson, Big Hole, and Prickly Pear Rive a has now reached eastward to a point below the junction of the Ye stone with the Missouri at Fort Buford. It has also been observed by me throughout the Snake River country, in the Salt Lake Valley also the valleys of the streams of Colorado, Wyoming, and New M ico. From its habit of frequenting rather low grounds among rank etation, and the comparative ease with which it adapts itself to various conditions of climate, there is some danger of its becoming manently acclimated throughout the Missouri and Mississippi Valleys If this should be the case, some damage to crops must annually r therefrom.

Aside from these three species, there probably never need be fears of injuries from locusts in this region in question, unless it al be occasioned by *Melanoplus devastator*, the locust which has been occasion of some damage to crops in Northern California and South Oregon during the present year. This insect also occurs in the Up Yellowstone Valley, and if circumstances should favor its increa sufficient numbers, it too would become injurious.

All the remaining so-called "native species," with but few except

tial to wild ground, and but seldom venture upon cultivated
Their food consists of wild grasses and weeds which grow
om cultivation—in fact many of these locusts are partial to a
ne or some special group of plants upon which they feed to the
n of all others. Of these species there are many, all of which
e or less variable according to their distribution with reference
ude, altitude, and climatic conditions; and to note these varia-
)) of the most interesting features to the student of this family

is brief report, all that I have to say in reference to future proba-
is that there do not appear to be any indications of immediate
, although if there should be a succession of a few more years
rable to the increase of this group of insects as have been the
ree or four, there is need to fear another general locust scourge.
er favorable these conditions should prove, there never can be
such a general and destructive spread of locusts as the country
l during the years 1873–'77, inclusive, for reasons which there
eed present of discussing. That the several species of de-
ve locusts are now on the increase throughout the Rocky Mount-
n and portions of the Northwest is quite evident, from the
reports to that effect are continually being received
tions of those regions; and that the "native" species,
as various insects, are likewise on the steady increase is also
, since the causes which permit of the one's increase will also
r favor that of others of like nature.
eferring to the following list of locusts which were noticed in
numbers than usual while in the Northwest this time, it will not
rising that much injury was done to the grasses upon the ranges;
contrary, the surprise will be that every spear of grass was not

a neo-mexicana, Thos., common; *Opomala brachyptera*, Scudd.,
); *coryphus obscurus*, Thos., common; *Chloëaltis viridis*, Thos.,
n; *Chloëaltis punctulata*, Thos., common; *Acrolophitus hirtipes*,
mon; *Stenobothrus maculipennis*, Scudd., common; *St. æqualis*,
common; *St. gracilis*, Scudd., common; *St. coloradus*, Thos., very
n; *St. curtipennis*, Scudd, common; *Gomphocerus clepsydra*, Scudd.,
n; *Camnula pellucida*, Scudd., very numerous; *Arphia teporata?*,
common; *A. tenebrosa*, Scudd., common; *Aulocara elliottii*,
very common; *Aulocara* sp., common; *Spharagemon æquale*,
common; *S. collare*, Scudd., common; *Circotettix carlingianus*,
ommon; *C. undulatus*, Thos., common; *Trimerotropis fontana?*,
ommon; *Dissosteira carolina*, Lin., common; *Hippiscus rugosus*,
common; *H. corallipes*, Hald., common; *H. (?) neglectus*, Thos.,
mmon; *Phlybostroma parva*, Scudd., *Stenobothrus 4-maculatus*,
uite common; *Hadrotettix trifasciatus*, Say, common; *Œdipoda?*
i, Thos., common; *Mestobregma kiowa*, Thos., common; *Boöpedon*
Thos., common at one or two localities; *Pezotettix albus*, Dodge,
n; *Pez. nebrascencis*, Thos., common; *Pez. borealis*, Scudd., com-
Hesperotettix viridis, Thos., common; *Melanoplus femur-rubrum*,
r, common; *M. atlanis*, Riley, quite numerous; *M. spretus*, Uhl.
farming in some localities; *M. cinereus*, Scudd., common; *M.*
, Scudd., common; *M. bivittatus*, Say, common; *M. luridus*,
mon; *M. gladstonii* n. sp., common, Sully County, Dakota;
, Scudd., quite common; *M. kennicottii*, Scudd., rare, feeds
: *devastator*, Scudd., common; and *Brachystola magna*,

NOTES ON LOCUSTS AT AND ABOUT FOLSOM, CAL.

By ALBERT KOEBELE.

ALAMEDA, CAL., *August* 6, 1885.

DEAR SIR: In accordance with your instructions, I went to Folsom, whence I could visit the place of the Natoma Water and Mining Company, which company has done the most in the destruction of locusts. I also visited other places along the foot-hills, especially White Rock and its surroundings, which are known everywhere as the breeding-grounds of the locusts. The Indians visit this place yearly for the purpose of laying in a supply of locusts.

It will not be necessary to relate in detail the mode in which locusts are collected by the Indians, but, in brief, it may be said that a funnel-shaped hole is made in the ground, the walls of which are smoothed with clay, and the insects are then driven into it and killed with boiling water, after which they are dried, and thus may be preserved for use at any time. The water is heated by plunging hot stones into it.

All these places, where the locusts were so destructive, are situated just along the foot-hills of the Sierra Nevada. These hills are generally bare and very dry. The best breeding-place I have seen (White Rock) consists of hills from 100 to 150 feet in height, entirely destitute of trees and shrubbery, rocky on some of the highest parts, with red, sandy soil, which in most places is only a few inches deep, resting on solid rock, the greatest number of locusts always issuing in such places.

The Natoma Water and Mining Company's land lies about 5 miles west of this. This company owns 8,700 acres. About 3,350 acres this are under cultivation; 200 in fruit orchard, consisting of p peach, and pear trees; 1,950 in vineyards, and 1,200 in grain; the is broken and waste land. On the eastern side this land rises to 75 in height, sparingly covered with oaks, and well situated for bre ng-grounds; yet the most of the young locusts have hatched betwe and the vineyard, on a bare slope. Many trees and shrubs grow alo river to the west, and very few locusts were ever noticed there; yet they appeared about the middle of March in large numbers al roads, and especially along the railroad, which runs through grounds, and were noticed especially issuing after every rain. began to migrate about the middle of April, and were then from three-eighths to five-eighths of an inch in length. The Natoma Company once set to work to destroy them. Along the roads and on the waste land straw was set on fire, as the "hoppers" continually came anew from the hills. This fire was kept up or renewed every few days until about the middle of April, when the insects became winged. Each new swarm would feed on its dead and roasted companions, and if a living individual were unable to rise, a half-dozen locusts would at once jump at it and in less than five minutes nothing but the legs would be left. Men especially employed for the purpose placed straw along the waste land and along the roads, drove the insects into it, and set it on fire on both sides. In this way large quantities of locusts were destroyed.

A channel about 10 feet wide runs along the eastern part of these lands, and as the movement of the locusts was such that nothing could hinder it, they jumped right into the water all along this channel, and were swept down-stream, to be collected in traps constructed for the purpose. The traps were made of a box 6 feet long, 3 feet broad, and 3 feet high, with strong screens on the sides to allow the water to

aps were placed along the side of the channel. A board ran he channel at an angle of about 45°, and 2 inches below the In this way all the hoppers were swept into the box, and men ntinually at work taking them out into bags. In this way 200 the insects were collected, or about 20 tons, and 4,500 were to a pound. More than twice this number were destroyed by he expenses of collecting them in the ditch were $200, while destroying them by fire amounted to $3,000; and yet no one, g the numbers that remained in June, would have supposed y ever had been molested.

little could be done after the locusts became winged. The best and that very good, in destroying them in this State was by a everywhere used in July, viz, by the use of a mixture of 1 part 3 parts bran, moistened with sirup diluted in water. In ice of this, from 75 to 100 dead insects were counted inside of s after it had been set out, on every place in which the poison n left, and a few days afterward about a quart of them was seen interval of about 10 feet. This poison was only made use of Natoma company amongst young and non-bearing vines, as there e great danger in using it amongst bearing plants, since the will always give out a brown substance after eating it and soil ing around them, and as there is no rain to wash it from the might have serious effects. It should be kept away from bear- its, or if it is used there no use should be made of the grapes.

winged insects began to leave their feeding-ground at the begin- July, although large numbers were still in the Natoma vine- hen I left there (July 28), but none in the fruit orchards. They began to migrate during the hottest part of the day, from 10 to ally letting themselves be driven with the wind at first, and ittle while turning against it, to rise not in swarms, but *always* , more like a snow-storm; those going high are soon lost out of They were observed going south, in this way, when a mild wind wing from the southeast, during several days after the middle They could be seen at and after midday by looking closely ecting the eye from the sun, some as low as 50 feet, and others npossible to tell how high. Looking through the opera-glass d be seen passing at every moment.

hapman, of White Rock, told me that late in October, last year, arly half way up in the Sierra Nevada Mountains, one evening, tle while he saw one of these hoppers come straight down as if clouds, but none could be observed flying about. This would at they sometimes must rise very high.

this year they had already hatched early in March, they ap- newhat later last year, not before the end of April, and chiefly White Rock. There they then destroyed everything, as they l all summer, while this season they disappeared as soon as they winged, and on my visit to that place (July 14 and 15), I was no locusts were around. I visited all those bare hills 2 miles t and 6 miles to the south, and found the locusts still scattered e; but in the valleys, where some water and green grass could they were still very numerous; even all the dry grass was ull of them, feeding on the seeds as well as on all the dry plants.

oss Clarksville and over the woody hills toward Marble d them plentiful, feeding on leaves of the various oaks rything green. I have seen a large patch of pines (*Pinus* most entirely stripped of their leaves, but the most of the

leaves were lying on the ground, as the locusts nip them off branch.

Marble Valley is situated between woody hills, and here the locust did also a great deal of damage. Higher up in the hills, about 18 mile above or east of Folsom, along the American River and north to th Central Pacific Railroad, I was told everywhere, during my trip in thi direction, that the locusts appeared only occasionally in small places, bu here the woods are plentifully filled with them. The Natoma compan after all its praiseworthy efforts to destroy them, loses nearly everythin The pear trees were nearly stripped of their leaves, but the fruit was much injured; the loss is about 4 tons out of 60. Out of 15 tons of cots they lost one-third. Fifteen acres of peaches are nearly all de oye and nothing is left but a mass of stones lying on the ground; on trees the foliage has not been much injured. The loss of plums is slig the young trees were stripped altogether. Coming to the viney here it looks bad; hundreds of acres of young plants look as if with not a leaf left, and where they cannot be irrigated many of must die, since they have no protection from the hot sun above, and rain to be looked for for the next three months.

As the insects marched in a body, in no particular direction, as there was food, they sometimes left a spot uninjured. The old p were eaten out from below and from the inside, while the ins yet unwinged, but afterward they were eaten from the top and Thus on trees the upper parts looked the most bare. The pedic grapes were cut off, and the ground was full of grapes, or they still hanging in a dried condition on the plants. Owing to the pl being nearly leafless the grapes were burned by the hot sun, and accor ing to the last account I have heard, very little will be saved out of 1,300 acres of bearing plants.

As to the enemies of the locusts, I have found no parasites on t except the flies already sent to you. I have brought along seve dred locusts, but apparently very few of them are parasitized. often watched the Tachina flies and their manner of laying eggs on locusts. They are very restless, and every time a "hopper" gets on wing they will attempt to get between the wings. I have held my sect net in front of me, folded, where they would sit on it, and by ing along slowly I could notice them nicely going for every locust flew up, and returning again after their attempt. Generally the hopp will let himself drop as soon as the fly gets between his wings, and r the fly off with his legs. These flies are found everywhere where t "hoppers" are, yet not in very great numbers, although the ground b neath the fruit trees at Natoma was full of their pupæ, and all the "h pers" which were here dead by the thousands were destroyed by

At White Rock the locusts died by tons during May, but I w able to find out the reason. They would sneak into any shady under houses, in cellars, under boards, &c., and die. The air was f the bad smell from the decaying insects. All the wells and holes we full of them; they were so abundant that they had to be shoveled aw from the entrances to the houses. Mr. Chapman, who had 1,000 fow 800 of which were turkeys, had fed them and his pigs besides on nothi at locusts for five weeks. Two hundred of the turkeys died from effects of eating them; their crops were found dried up. I have exa ned the ground carefully wherever the locusts died in such numbe and have found some of the dipterous pupæ, yet not sufficient to pro that they were the destroyers. Still, everything had been scratch over and over by the hungry fowls after the hoppers had left. T

may have been some other cause besides the flies, but it was not hunger, for at that time plenty of food was left.

The *Chalcid* which I have already sent you seems to be parasitic on the Dipterous larvæ while they are still in the locust. This will be easier for you to decide. I am only certain that they were inside of the 'hoppers and came out with the Dipterous larvæ issuing from their pupæ. Since that was sent two more have been bred from Dipterous pupæ obtained from the 'hoppers.

When infected with Dipterous larvæ the 'hoppers lose the power of their wings, or do not make use of them as in the healthy state, yet they are still very active. I have found them still alive after the larvæ had left them. The larvæ will nearly always come out on top of the neck, or between the epicranium and prothorax; if there is a hole here the larvæ have nearly always left their prey; sometimes others may still be found, as their number varies from one to six in each locust in several hundred which I have examined. In one instance I found three young larvæ in one of them which already had this hole on the neck, showing that they were evidently of another brood; this fellow was not very lively any more.

While at rest, if any wasp, fly, or other insect came near them, they would always lift their hind legs in a vertical position, and keep them so until the danger was over. The many peaches on the ground attracted a large number of insects, but none were noticed interfering with the locusts; all joined in devouring the fruit; even their enemies, the flies, very seldom tried to fly after them. I saw one Digger-wasp devouring a fresh locust in the grass; another of the same species was flying about and, seeing its companion, joined him. They were driven away, but always came back to look for it. I did not see any in the act of killing a locust.*

Various birds were seen eating them, amongst them a flock of about five hundred blackbirds, which came to a certain place every day where the locusts were very numerous.

Yours, respectfully,

ALBERT KOEBELE.

Prof. C. V. RILEY.

INSECTS AFFECTING FALL WHEAT.

By F. M. WEBSTER, *Special Agent.*

LAFAYETTE, IND., *October* 15, 1885.

SIR: I herewith submit my report upon the insects observed affecting small grains, more especially wheat, during the season of 1885.

For the determination of material, as well as for numberless other favors, I am indebted to yourself and your assistants. Whatever advance I have been able to make in the study of these species has been largely due to your aid.

Respectfully submitted,

F. M. WEBSTER,
Special Agent.

Dr. C. V. RILEY,
United States Entomologist.

ISOSOMA TRITICI Riley, and I. GRANDE Riley.

At time of making my report last year these two species were en- the straw as larvæ. By the 17th of October nearly all of these

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id referred to by Mr. Koebele from Tachina pupæ is *Chalcis ovata* Say, very variable in size, and some measuring only 3mm in length. The *Prionomyx atrata*, as kindly verified by Mr. E. T. Cresson.—C. V. R.

larvæ had passed to the pupa state, and, with the exception of the appearance of two small, wingless females of *tritici* on the 20th of the same month, nothing further transpired to indicate that, under normal conditions, they would transform to adults and emerge before the following spring.

As the weather became cooler, during the last of November, we placed a quantity of infested straws in a glass jar, and this was kept in a room where the temperature was continually from 68° to 70° F., the remainder of the straw being allowed to remain out of doors.

Nothing appeared in the jar until the 7th of December, when, in the morning, a single wingless female of *tritici* was found crawling about on the inside of the glass. She was very small, seemed feeble, and, in fact, died during the afternoon of the same day.

On the following day a second female appeared, in all respects like the first, only more active, stronger, and larger. A third example made her appearance on the 11th, followed by another on the 14th, and another on the 16th, all females, wingless, and all *tritici*.

As fast as they emerged from the straw they were placed on growing wheat plants, covered with large glasses, but none seemed in the least inclined to oviposit; all were apparently in search of some avenue of escape from their confinement, and refused to remain on the plants for any length of time.

Another female appeared on the 22d, and in the mean time two had died. This state of affairs continued until the 3d of January, when the only remaining female was found dead. Another, however, appeared during the same evening.

From this time until the 14th of February adults continued to emerge, but after this date none were noticed, although the straw was kept in the jar until June. The attempt to induce them to oviposit had, from first to last, proven a total failure. The question of what had become of *grande* was now the foremost.

The infested straw had been taken from very near the exact spot in the field where females of that species had been observed to oviposit in great numbers, and yet not a single one had been obtained. The result could be summed up in just three words, females, wingless, *tritici*.

The straw remaining outside was again divided, the major portion being taken indoors. But, with the exception of demonstrating that *tritici* would begin to emerge, whenever the temperature rose, during the day, to about 62° F., although it might sink to 30° F. during the night, the results were as unsatisfactory as before.

The last of these straws were taken indoors, but the results did not differ in the least. It was now the 20th of March, and a limited number of straws still remained, in breeding-cage No. 38, placed therein on the 6th of June of the previous summer.

These straws had been transplanted from a field of wheat near Oxford, Ind., and a number of females of *grande* had been placed in the cage, where they had been observed to oviposit on the 6th of June of last year, the day the straws were transplanted.

The straws were frequently watered, and kept in growing condition, so that they matured simultaneously with those in the field from which they were taken, and it was in this condition that they were brought to La Fayette, when we changed our location in November.

The cage had, soon after the change, been placed in a sheltered location outside one of the university buildings, where it still remained.

On the 23d of March a single adult appeared in the cage, followed during the remainder of the month and the first week of April by

ers at long intervals, but they were all *tritici* and like those pre-
isly bred from the other straws.

o settle the matter beyond the possibility of an error, after the
lts had ceased to emerge, we proceeded to slit open the straws with
iew of learning if any pupæ of *grande* remained to emerge later in
season, or if any had died and thus failed to appear.

As we cut open the last straw, and found it, like all of the others,
roid of *Isosoma* in any condition or stage of development, the last
e to the enigma we sought to unravel seemed to vanish.

Up to the 20th of April inclement weather during a large portion of
el kept us from making extensive observations, but during the
ider of this month we were almost continually in the fields, search-
g fully any young wheat plants showing injuries at all suggestive of
work of *Isosoma*. As much of the wheat had been seriously affected
extremely severe winter just passed (not only were many of the
ts killed to the ground, but many others even up to the time of
ng showed the effects of less serious injuries), our task was alike
and unremunerative; although, had we at that time known
at we have since learned, and directed our attention to the healthy
instead, the results might, possibly, have been more satisfactory.

After t 1st of May, previous labors in this direction having been
(ing, we devoted less time to inspection of the plants, but
e evidence of unnatural or retarded development were
ly ined, and, as we were almost daily in the wheat-fields
l the wheat and grass saw-flies, our attention, though not
ive, w s continually directed to the matter. On the 1st of June,
a narrow strip of timothy and blue-grass, bordering a small field
ing wheat, on the university farm, we swept two females of
na grande, and on the next day, in a field of wheat that had been
t over on the 29th of May without capturing a single one, several
re were taken—all females. Determined now to solve the mystery
these insects having so long evaded search, a thorough examination
the growing wheat was begun, excepting only the very few now in
ad.

We found (1) that it was the apparently healthy plants that were in-
and (2) that little or no trace of the insect was to be discerned
outside appearance until after the adult had emerged, and (3) that
va did not as a rule attack the culm after the manner of others
the same genus, but confined its work to the undeveloped head, and,
upper sheath and leaf continued to grow, the affected part was
until later in the season. We now found the species *grande* in
of its stages in the plants, and also found plants from which the adult
emerged, and, while the wheat head was almost invariably entirely
away, in some cases the larva had evidently pupated before the
of destruction was complete, and a distorted, misshapen head was
orth, and while all infested plants were more or less dwarfed, it by
ns followed that all such plants were infested.

As nothing definite respecting the previous history of this field could
ned, our attention was directed to one of the experiment plats
ne university farm.

A plat was sown on the 29th of September, 1884; much later, we
rmed, than the field previously mentioned, and at the beginning
the plants were much smaller. Notwithstanding this, it was
difficult to distinguish the infested plants by a superficial in-
although they were nearly if not quite as numerous.

the females of *tritici* exercise any discrimination in the

selection of the plants in which they oviposit is uncertain, but that those of *grande* do, to a marked degree, there is every reason to believe.

During the ovipositing season of 1884, and also that of the present year, when the females of *grande* were very abundant over those parts of the wheat fields where the grain was very thin, scarcely any could be found where the plants were thickly set.

When the plants stand at a distance from each other there is a tendency to throw out large, strong, vigorous "stools" slightly less advanced than the main plant, and these are, to a very notable extent, selected by the females in which to oviposit, but, contrary to an opinion expressed in our report last year, they invariably choose the upper joint from first to last during the season.

This seems the proper place to present some facts bearing upon the date of oviposition, and the relation that the two species sustain toward each other. And in this we do not wish to be understood as doing more than arrange the facts, to the best of our judgment, in their proper relation with reference to these two questions, and therefore not express any opinion on our part as to what the results of future studies may or may not prove.

Whatever bearing the fact of *grande* having been found in spring in the larval stage, in wheat sown late the previous autumn, may have on the matter, it seems to us it is largely, at least, in favor of spring oviposition.

It is nowise probable that the parent female could, in the fall, distinguish between a plant that would survive the winter and one that would not, particularly if the winter was one of unusual severity, as was the case with that of 1884–'85. So, then, we might reasonably expect that those plants that failed to survive would contain very nearly their pro rata of larvæ or eggs, it is immaterial which, as all larvæ would, it seems to me, sooner or later perish of starvation. If, as was the case last winter, from 25 to 75 per cent. of the plants failed to survive, we should reasonably look for a notable decrease in the number of adults that would emerge, whereas they were, if anything, more abundant the present season than they were during the preceding. Then, too, if the eggs had been deposited in autumn, the larvæ would have been found in plants suffering from various degrees of injury by reason of the severe winter, while with industrious searching they were not so found. But, allowing the females of early spring to possess the same sense of discrimination that is shown by those appearing in June, we should expect them to oviposit, not in the largest and toughest plants, but rather in the tender, vigorous stools, just where I found the larvæ, pupæ and adults, as previously stated.

Again, even though we admit *grande* to be the offspring of *tritici*, there are not enough facts at hand to indicate that, in this latitude, at least, enough emerge in the fall to produce the former species in any such numbers as appeared in June.

On the other hand, the adults could not have emerged the previous year much prior to the 25th of March; in fact, the snow had lain and appeared from the fields by the 15th. This would give us a period of a little over two months intervening between the emerging of the parent insect and the appearance of adult progeny.

That during the earlier part of this period the temperature was sometimes quite low is shown by the following table taken from the records of the signal station at Purdue University:

Average mean daily temperature of last fifteen days of March, 1884, 29°.82; same for first fifteen days of April, 43°.05; same for last fi

s of April, 55°.26; same for first fifteen days of May, 52°.30; same
r last sixteen days of May, 66°.26.
The average temperature from the 15th to the 22d of March was 15°.87.
the 23d, the day my first adult appeared out of doors, the average
e had risen to 25°.50.
These figures are also interesting as indicating the influence of me-
ological conditions upon the insect in its earlier stages, and how lit-
we may expect from this direction in keeping the pest in check.
While, as above indicated, we have no facts that enable us to account
r the appearance of *grande*, except that they are the offspring of
, it does not seem to necessarily follow that all eggs deposited in
spring develop into *grande*.
The adult *tritici*, bred the 20th of June, 1884, together with the dead
dult found a few days later, were both from plants removed from a
near Bloomington, Ill., the 9th of May, both straws showing am-
evidence that these adults were the result of spring oviposition,
by raising the perplexing question as to what condition or environ-
is necessary to cause some eggs to produce *grande* and others
a question that I am not in a position to answer.
if possible more puzzling, complication arises from the fact
; all of the specimens of *tritici* or *grande* that I have either
r captured, not a single male has been observed, and all have been
y scanned with this point in view, except such as were transferred
the field to plants under cover for the purpose of securing eggs
r future experimentation.
All observations relative to the period during which *grande* exists in
dult verify those made last season.
An occasional adult was observed on spring wheat, but, although the
rass-land where the two first females were taken was swept over
gain and again, no additional examples were obtained.
We now have wheat-straw reared under cover of Swiss muslin, and
straw taken from the fields, in both of which I know *grande* to have
viposited, and besides these a good supply of plants, reared during
present autumn, also under cover of muslin.
By breeding and experimentation, both indoors and out, we may hope
in some light on the obscure points in the life-history of these

THE GRAIN SPHENOPHORUS.

(*Sphenophorus parvulus*, Gyll.)

Soon after locating temporarily at Oxford, Ind., in June, 1884, my at-
on was several times called to the fact that a field of rye, near town,
, the previous season, when fully headed out, been affected by some
nculty which caused many of the straws to wither and die from the
d upward. During the latter part of June a similar trouble was
ed in a rye field, and an examination of some of these affected
ws revealed the seat as well as the source of the trouble. Between
first and second joints above the ground was found a small, robust,
larva, with a brown head. As the bodies of these larvæ were
ntly large to fill the cavity in the straws, we supposed that they
nave reached very nearly their maximum growth, as there was no
they left one straw to enter another.
o breed these, however, proved altogether abortive, and a
secured with no better success.
of July we found in wheat straw not only larvæ in all
found in rye, but eggs also, in the same position.

This portion of the straw, that is, the space between the first an second joints above the ground, very frequently differs from that furthe up, by being nearly or quite solid, and consisting of a very juicy sul stance. And through the hard outer wall of this part of the straw where the eggs were found, were small, slit-like punctures, made by th parent insect in order to introduce her egg.

On the 11th of June, of the present year, these larvæ were f the stems of wheat as they had been on several occasions the pre season, and on the next day, the 12th, much of the obscurity whi heretofore hung about the matter was dissolved by finding two females of this species puncturing the lower part of straws in a plat barley on the university experiment farm, a contiguous plant sho a freshly-made puncture in every way resembling those being excav by the two females, and also those noted the previous summer.

Profiting by previous failures we did not now attempt to r larvæ in confinement, but watched carefully for any changes in the in order to determine what became of these larvæ after they hau grown their habitation in the straws, as it was now apparent that could not acquire their full growth therein.

On the 2d of July many had left the straws, and were then fe on the roots, thereby, to a greater or less degree, injuring straws co tiguous to the one originally infested. We now transplanted to breeding cage a clump of healthy wheat straws, and among the of this placed a number of half to two-thirds grown larvæ from roots in the fields.

On the 7th of July the larvæ were doing considerable damage spring wheat, working both in the straw and among the roots.

On the 16th of July, in a field of oats near Goodland, Newton Count Indiana, what seemed nearly a full-grown larva was found feedi among the roots.

The larvæ, on reaching maturity, apparently crawl to one side construct a rude earthen cell in which to transform; at least no p were found among the roots of the grain.

On the 24th of July some of the larvæ placed in the breeding on the 2d instant had pupated, and pupæ were also found in the fi

A number of clumps of injured grain were examined that had grov among young clover, but the larvæ had, so far as could be seen, con their work to the grain.

On the 11th of August, two adults appeared in the breeding cage, f lowed a few days later by another, after which no more emerged. B as larvæ were observed on the 11th of June, and eggs were found season on the 1st of July, it is more than probable that their breedi season and consequent period of emerging is considerably pro There is but one brood in a season, as the adults are found in g numbers in northern Illinois, from October to May, hibernating boards, old rails, and like rubbish.

Dr. Riley is, I believe, authority for the fact that this speci jures corn in Missouri, and we have also observed the adults pun ng young corn in June, just below the surface of the ground.

THE WHITE GRUB.

(*Lachnosterna fusca*, Fröh.)

That injuries caused by the previously-mentioned spe quently attributed to the one now under consideration, by

we e roughly convinced. These larvæ are, however, clearly
a distinguishable from those of the *Sphenophorus* by their
uny velo d legs and the internal dark color so noticeable in the
: s nents. The White Grub, however, is a by no means in-
t e my of the small grains.

During tumn there is hardly a field of wheat here in Indiana that not, to greater or less extent, show the effects of their voracious tes.

Their method of work in the grain fields seems to be much more erratic than in grass lands, as the many clusters of from two to twenty, or perhaps more, dead plants that have been eaten off below the surface will illustrate.

Their work in spring wheat and oats during spring is usually less noticeable, and we have never observed the grubs feeding on the roots of spring-sown grain later than the 15th of May. This is, no doubt, largely due to the fact that the fresher and more tender roots of the weeds and grass that spring up in the fields offer more tempting morsels.

THE TARNISHED PLANT-BUG.

(*Lygus lineolaris*, Beauv.)

Adults were observed in numbers about equal to those of last season, extracting the milk from immature kernels of wheat, apparently being much more destructive to the spring than the fall varieties.

EUSCHISTUS FISSILIS Uhler.

These also were depredating in the same manner, but in greater numbers than last year. After the fall wheat had become too advanced to afford them the requisite supply of food, they gave spring wheat their undivided attention, and must have done considerable injury.

DRÆOCORIS RAPIDUS, Say.

Although not aware of this species having been reported as injurious to small grain, we were not surprised to observe adults, in limited numbers, in company with the two species previously mentioned, depredating on both fall and spring wheat in precisely the same manner as the others.

No inconsiderable injury to the wheat crop, and in particular to the spring varieties, seems to be due to the withering and shrinking up of portions of the heads while the kernels are filling. Sometimes the upper half, or perhaps one-third of the head, will wither, or very frequently the trouble will affect only a cluster of one, two, or perhaps more kernels, while the remainder will be in good condition. The result of this is that many kernels are aborted, and eventually go over with the chaff when thrashed, and sometimes there is no kernel whatever in the glumes.

While this may not be due to the punctures of any or all of the three s of *Hemiptera* mentioned, this much is certain: First, the trouble more noticeable where these insects appeared the most abundant; l, the trouble was not perceptible until these insects began their d, third, the heads of wheat reared under a frame-work of overed with Swiss muslin, and consequently protected from all k, exhibited no injury of this nature.

DIEDROCEPHALA FLAVICEPS, Riley.

Dr. Riley, himself, states (*American Entomologist*, vol. 3, p. 7 this species was injurious to both wheat and oats in Texas in 1 we refer to it here only to record the fact of eggs and larvæ bein in the lower part of oat straws on the 10th of July.*

THE CHINCH-BUG.

(*Blissus leucopterus*, Say.)

The habits of this insect were, the present season, somewhat trast with what they were as we knew them in northern Illinois, to twenty years ago, when their first depredations in fields of wheat were marked by small spots of injured grain, these g larger as the insects became older or more numerous.

The present season, the adults took possession early in May, a tributed themselves so uniformly over the field that by the 20th there was but one affected spot, and that the whole field. The seemed to gradually and with perfect uniformity, extract the li the entire field.

Last season they were extremely abundant in a field of fall that had been badly killed out from some cause, and therefore v only thin on the ground but backward in ripening. There had up a thick growth of Bottle-grass (*Setaria glauca*), and when th was harvested, the 11th of July, we expected to witness a genu gration. But, instead of this, the bugs simply transferred thei tion to the Bottle-grass, and subsisted thereon until they had fi veloped.

When molting for the last time, in August, the pupæ crawle into the stubble, where the straw had been cut off between join left their cast-off skins in the cavities. I have counted upv twenty of these in a single cut stalk.

In one such stalk, among the dried moltings and two or thr bugs, I found a species of *Mermis*, which fact would lead to t picion that these parasitic worms infest the Chinch-bug as well a insects.

THE WHEAT MIDGE.

(*Diplosis tritici*, Kirby.)

In my previous report upon this insect were recorded all o tions up to the 15th of September, 1884. Adults were bred from teer wheat on the 23d, and again on the 30th; and on the 1st of O from a field of wheat near Oxford, Ind., sown among corn dur last week of the preceding August, I swept a number of adul on the 3d, under the sheaths of some of the wheat plants, I found larvæ.

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* These eggs, judging from alcoholic specimens sent by Mr. Webster in Ju are laid in a regular row. A separate slit is made for the reception of each matter how closely they approach each other. In some cases only a mere fil straw separates them. The egg itself is 1.2^{mm} long, and about six times as lo ventral width. Its protruding portion, about one-sixth of its length, is close cap, the diameter of which is as great as the widest portion of the egg. T considerably bent, and thickest at the end inside the straw. The inclosed pa is reddish, while the exposed portion has the color of the straw.—C. V.

This field was located at least a half mile from any other whereon eat or rye had been raised during the season, and from it I again ob- ned adult midges on the 10th, and again on the 14th of October. On 16th of the same month the adults were also very abundant about unteer wheat in the fields. On going out just before sunset, and lying wn among the plants, I could see them flying about in great num- between and just above the plants. They were again observed in locality on the 24th, after there had been several nights of suffi- ly low temperature to freeze water to the depth of half an inch. my last observation for the year was under date of 3d of November, which date an adult appeared in a breeding cage containing volun- er wheat. This cage had been kept continually out of doors, and was e same from which adults were obtained on the 23d and 30th of Octo- r.

The first adult observed the present season appeared about my lamp evening of the 20th of May, from which date they were observed, the same circumstances, in increasing numbers, until by the 1st June they were very abundant.

But a single individual was observed in the fields during this time, s because only an occasional head was to be seen in the early- n wheat, and it was not until the 10th of June that pollen was noted wheat heads.

the 13th of June, in the field near Oxford, Ind., where I had ob- the insects so late the previous autumn, I found nearly full-grown æ on the heads of wheat and also swept adults from the grain.

railing to find either larvæ or adults in the fields about La Fayette, , I again visited the Oxford field on the 19th of June, and found n larvæ and adults rather more numerous than on the 13th.

On the 20th I found the larvæ on heads of wheat of a beardless va- , in a field on the university experiment farm, and the same day d on my lawn, in town, a head of blue-grass, not yet put forth from e sheath, infested by quite a number of larvæ.

The larvæ did not appear in any considerable numbers during the ason, and I could not observe or learn of their doing any perceptible jury.

Adults, however, continued to flock to my lamp during warm even- up to the middle of August, and a very few until September, but did not occur in the fields or about volunteer wheat as they did season.

IRD REPORT ON THE CAUSES OF DESTRUCTION OF THE EVERGREEN AND OTHER FOREST TREES IN NORTHERN NEW ENGLAND.

By Dr. A. S. PACKARD, *Special Agent.*

In tinuation of the work of the preceding year, I have to report nere were observed or brought to my notice, in the season of 1885, of wide-spread or local destruction of evergreen or hard-wood No extensive journeys were made into the Northern forests; the was spent on the shores of Casco Bay, Maine, and the time to observing forest insects and rearing species of Lepidoptera -fly larvæ. A considerable number are at the time of writing is state, and I hope to be more successful than formerly,

owing to improved apparatus, in carrying them through to the state.

While no general destruction was observed, yet forest trees, a pecially evergreen trees, support, each year, hordes of caterpillar prising species of different families. In beating the branches spruce, fir, larch, poplar, or maple, and especially the Oak, a grea ber and variety of caterpillars are shaken down, and the question whether the innumerable host constantly and ordinarily at worl spring time to the fall of the leaf in our forest trees are really injuri the tree. It is not improbable that good is done to the tree by the racious beings. The process up to a certain limit may be one of n and healthy pruning, but there is no certainty that the limit at any time be overstepped and destruction ensue. The tree is at in a multitude of ways by caterpillars alone. The buds are ea various leaf-rollers (Tortrices), the leaves are mined on the upp under sides by various Tineids, while the leaves are rolled over n ous ways and in various degrees to make shelter for the caterpill they are folded on the edges, or gathered and sewed together by T Tortricid, and Pyralid larvæ. The entire leaves are devoured by tudes of species of larger caterpillars, belonging especially to the lid, Geometrid, Bombycid, and Sphingid moths; while certain prey on the fruit, acorns, nuts, and seeds.

It is a singular fact that of the great family of Owlet or N moths, of which there are known to be 1,200 species in this co very few feed on trees, the bulk of them occurring on herbaceous and grasses.

While the smaller caterpillars (*Microlepidoptera*) feed conceal tween the leaves or in the rolls or folds in the leaf, or in the bu caterpillars of the larger species feed exposed on or among the l Here they are subject to the attacks of birds and Ichneumo Tachina flies, which are constantly on the watch for them. An curious to see how nature has protected the caterpillars from ob tion. While the young of the smaller moths are usually green, the same hue as the leaves among which they hide, or reddis brownish if in spruce and fir buds, where they hide at the base needles next to the reddish or brownish shoots; the l r kin variously colored and assimilated to those of the leav l among which they feed. Were it not for this they would be up by birds. Of course, the birds devour a good many, and ing Ichneumon and Tachina lay their eggs in a large proportio those which do survive owe their safety to their protective colora

Of some twenty or more different species of Geometrid cater which occur on the evergreen trees, some are green and so stripe white that when at rest stretched along a needle, they could wit culty be detected; others resemble in various ways, being brow warted, the small twigs of these trees; and one is like a dead, red the fir or hemlock. There are several span-worms on the oak, in color and markings, as well as the tubercle and warts on the resemble the lighter or darker, larger or smaller knotty twigs; t semblance, of course, is in keeping with the characteristic habit of worms of holding themselves out stiff and motionless when no ing.

In an entirely different way the various kinds of Notodontian pillars, which feed exposed on oak leaves, are protected from ob tion. They feed on the edges of the leaves, and their bodies are with brown patches, so that these irregular spots, when the cate

r › closely similar to the dead and sere blotches, so frequent . The same may be said of other kinds feeding on the m otner forest trees.

l › bodies of those noctuid caterpillars which feed on herba- s › smooth, those of the tree-inhabiting *Catocala*, *Homo- t ocyma* are mottled with brown and ash like the bark of the and provided with dorsal humps and warts, assimilated in form co to the knots and leaf scales on the twigs and smaller branches. e thus a close harmony in color, style of markings, shape, and of t › humps and other excrescences of tree-inhabiting caterpil- a it lue to this cause that they are protected from the attacks r (mies. Mr. Poulson has recently called attention to the fact pillars are extremely liable to die from slight injuries, owing to t bodies and thin skins. They cannot defend themselves when discovered. The means of protection are of passive kinds, *i. e.*, s render the delicately-organized animal practically invisible on part of its enemies, and these means vary with each kind of cater- . In this way different kinds of larvæ can live on different parts leaf, the upper or under side, or the edge, on different colored s, on those of different sizes, with different kinds of leaf scars, s, or projections, and thus the tree is divided, so to speak, into so provinces or sections, within whose limits a particular kind of n y live with impunity, but beyond which it goes at the peril of ife.

CONDITION OF THE SPRUCE ON THE COAST OF MAINE.

my last report it was stated that as the result of journeys in the rent portions of Maine, including Aroostook County and the Moose- l Lake region, as well as a prolonged stay in Cumberland County, the Spruce-bud Caterpillar, the larva of *Tortrix fumiferana*, which, rmer years, had been so destructive to the spruce and fir on the coast between Portland and Rockland, had become scarce.

ear I have to report that not even a single specimen either of the ular or moth could be found on the shores or on some of the isl- Casco Bay. From this fact I conclude that this species has med its former proportions, being usually so scarce an insect in that, previous to 1878, when it became so alarmingly prevalent, it er met with by me through several years' collecting and obser- in spruce and fir woods, particularly during the period com- between the years 1859 and 1867.

oreover, throughout the areas of destruction, the young trees are ving up, and already, in some degree, have effaced the desolate ap- nce of the tracts which had been destroyed and from which the timber had been cut. Probably in twenty or thirty years from , if the land is suffered to remain undisturbed, a new evergreen for- will in many places cover the present denuded districts

CONDITION OF THE HACKMATACK IN 1885.

year's report I thus summed up the condition of our larches natacks in 1884:

whole, then, while a small proportion of larches have been this worm, this vigorous tree, though defoliated for two suc- seems, in the majority of cases, to survive the loss of gn it threw out much shorter ones the present summer.

Possibly 10 per cent. of our Northern larches died from the attacks of this worm. Very probably the numbers of this insect will diminish during the next year, and the species may ultimately become as rare as it has always been in Europe, until a decrease in its natural insect parasites and favorable climatic causes induce its undue multiplication."

The foregoing prediction has been almost fully verified during the past summer, as the insect has been much scarcer than in 1884. A few were seen on the larch in Brunswick, Me., in July, 1885, but they were not numerous enough to do any harm, and I have not heard of their devastations in any part of Maine. The same appears to have been the case in the Adirondack region of New York. Mr. George Hunt, who passed the summer at Scroon Lake, tells me that he saw very few of the worms during the past summer, and he judged that they had not been generally so destructive as the year preceding. As the result of their ravages during the preceding years, he thought that about one-third of the larch trees had died. It would seem as if the visitations of the worm were over, and that for some years to come it would be a rare insect, existing within its usual or normal limits.

THE WHITE PINE WEEVIL, AND ITS INJURY TO SHADE AND FOREST TREES.

(*Pissodes strobi* Peck.)

[Plate IX.]

For many years past our attention has been drawn to the deformities produced in forest trees by this beetle, as well as the injury it commits in plantations and to ornamental trees on lawns and about houses.

Dr. Fitch has already outlined the natural history of the insect in his fourth report. We have not yet been able to detect the beetle in the act of egg-laying. Fitch says that the weevil deposits her eggs in the bark of the topmost shoot of the tree, dropping one in a place at irregular intervals through its whole length. "The worm which hatches from these eggs eats its way inwards and obliquely downwards till it reaches the pith, in which it mines its burrow onwards a short distance farther, the whole length of its track being only about half an inch. But such a number of young weevils are usually placed in the affected shoots that many of them are cramped and discommoded for want of room. The worm on approaching the pith often finds there is another worm there, occupying the very spot to which he wished to penetrate. He thereupon, to avoid intrusion upon his neighbor, turns downward and completes his burrow in the wood, outside of the pith. Those, also, which enter the pith are often unable to extend their galleries so far as is their custom without running into those of others. When its onward course is thus arrested, the worm feeds upon the walls of its burrow until it obtains the amount of nutriment it requires and is grown to its full size."

The eggs of this species are probably similar in shape, but considerably larger than those deposited by the timber beetles, whose eggs and larval development are figured and described in the Third Report of the United States Entomological Commission (p. 280, Plate XXII, Figs. 1, 8, 9, 10). According to Ratzeburg, the European *P. notatus* lays its eggs in the lower internodes of young plants, boring into the sap wood with its beak. Its habits thus differ much from our species, and it does not seem to affect the terminal shoot. The grub or larva does not differ from those of other borers found in the pine, as there is

g rsistence of form in boring grubs, both of the weevil family bark-borers or Scolytids. The grub of *Pissodes strobi* (Plate . ig. 1 *a*) is rather slenderer than those of *Hylurgus*, *Dendroctonus*, *gops pinifex*. Compared with the latter very common borer 5mm in length, while that of *H. pinifex* is only 5mm to 6mm in ngth.

While from their similar tunnel-making habits the larvæ of the two milies mentioned are, owing to adaptation to their surroundings, very milar, the pupæ are very unlike, those of the White-pine Weevil being a glance distinguishable by their long snout, which is folded on the ; and the beetle, as seen in the figure, has a long, slender snout, the body is reddish-brown, with two irregular white spots, one the middle of each wing-cover. When engaged in laying their at the reddish-brown extremity of a pine twig, near the buds, weevils are undoubtedly protected by their shape and color from o rvation of birds, some kinds of which are constantly on the earch ror such beetles.

While living in their "mines" or tunnels, the grubs are exposed to ifold dangers from carnivorous grubs, particularly the young of eetles of the family *Tenebrionidæ*, &c. We have not detected any Ich- ion or Chalcid larvæ or flies in their burrows, but these are not un- non in those of the Scolytid bark-borers. At all events these insect ies keep the larval pine-weevils within due limits, otherwise their ous effects in forests would be more marked.

presence of the grub of the White-pine Weevil in a branch or ig or under the bark of a young or old tree may be at once known by s p liar cells. When the grub is full-fed and ready to change to the is state, it either transforms within a small branch in the pith or the bark. In the latter case it sinks an oval-cylindrical hole in ith wood, and builds up over it, in the space between the loosened and the wood itself a white covering, composed of the long chips of the pith wood, the little fibers being closely interwoven and u ther, so as to form a cocoon of a tolerably firm consistence, contrasts in its white color with the under side of the bark. The on thus made is not usually, if ever, lined with silk. The length of e ire cell is 12mm; its breadth is 5mm. *Hylurgus terebrans* con- s lar cells, but they are much smaller. Most of the bark- wever, do not transform in such cells, but in their tunnels.

t me insect is especially abundant in Maine, I have also found in abundance in September on the ornamental white pine bushes on grou s of the State Agricultural College, at Amherst, Mass. When e pine is set out on plantations it has thus far been tolerably he attacks of this pest. On the extensive plantation of Henry l, esq., at Greenwich, R. I., who has planted trees on a larger any one else in New England, only scattered trees have been . Fig. 2, Plate IX, has been drawn from a terminal twig on or t trees. Part of the twig was mined under the bark, the se together, there being seven or eight on one side of a rd of an inch in diameter. They run up and down the parallel, beginning small, when the larva hatched, ng slightly larger as the grub grew, until at the end of 4 or ney sink into the cell, the grub having become full-fed and ell for its final transformation.

pith is mined, the cells form enlargements of the tunnel, e case before us the cells are so thick as to touch each other, g six cells in a length of not over 2 inches. When the cells

are made exteriorly, but under the bark, they are usually about an inch apart, and, as we have said, at once by their light color and convex surface attract attention when the bark is torn off.

While this weevil does much injury to the young white pine trees, it is by no means restricted to such growths, but lays its eggs in the bark and mines the sap-wood of large pine and other coniferous trees.

Thus I have found the beetles more commonly, and in different stages of growth, in the white pine, April 24; at this date the beetles begin to appear; and the beetles do not all make their exit from under the bark and fly about by the end of spring, but I have found the bee under the bark May 30, and even as late as the 11th of August, w pupa and beetle occurred, the latter somewhat pale and immature.

This weevil is of common occurrence in the bark of spruce trees 6 to 10 inches in diameter, where I have found them, during the middle of August, at Brunswick, Me. The grub and pupa occurred near the House, White Mountain, New Hampshire, at the end of July in the mi; on the 30th of July I took five mature beetles from under the bark of a hemlock tree. I have never noticed, however, spruce, fir, or hemlock trees which had been deformed, as is not uncommonly the case with white pine.

The life-history of this weevil, then, in brief, is as follows: The e are laid early in summer, at intervals, on the terminal shoots of white pine, or sometimes in the bark of old trees; the grub on hat bores into the pith, or simply mines the sap wood; it becomes full-grown at the end of summer, hibernates, and transforms in the spring to pupa, most of the beetles appearing through May, when they pair the eggs are laid; but some delay their appearance till June, July, even August.

Thus far we have said nothing as to the remarkable effects produ by the grubs upon the young trees. When the terminal shoot of a sm tree, say 4 or 5 feet high, is filled in midsummer with these grubs, p haps fifteen or twenty, or more, gouging or tunneling the inner and sap-wood, and for a part of the way eating the pith, the shoot the lateral ones next to it, as well as the stock immediately below terminal shoot will wilt and gradually die; the bark will loosen, the pitch will ooze out, and by September the shoot will be nearly dead, and the bark covered externally with white masses of dry pitch.

The tree thus pruned will fail for one, and probably several, succe ing summers, to send out a new terminal shoot; the result will be t the adjoining lateral shoots will continue to grow, their direction will be changed to a nearly upright one, and instead of a tall shapely y tree, destined to be the pride of the forest—and there is no finer o mental evergreen tree in our lawns or parks than the white pine—it comes distorted, prematurely bent, or its noble shaft becomes by one, two, or half a dozen or more stunted, shriveled aspi leadership.

In walking through any forest of white pines of secondary grow New England or Northern New York, one's attention is drawn to deformed trees. They are not necessarily dwarfed, as some are the largest and noblest trees of the wood. They may occur often there are several, differently affected, growing near each though not in clumps. Some have but a single bend, a sing growing up, the original, and perhaps several, lateral shoots, have destroyed; one, we well remember, consists of two shafts which about 6 feet from the ground (see Plate IX, Fig. 3).

] r table example which we have seen in the Maine woods
m ood southwest of Bowdoin College, but which has since
uc 1. Fortunately, shortly before the destruction of the tree,
r 1 . G. L. Vose, then of Bowdoin College, to make a
ing or tree. He kindly sent us the accompanying excellent
e . te IX, Fig. 4), in part reproduced, with the following
r, giving the measurements of the tree:

BRUNSWICK, ME., *September* 5, 1881.

I send you a sketch of the tree, not, as you will see, in any way as a work of art, as make no pretense in that line, but as a botanic specimen. The arrangement of hes is according to nature. I took a point about 150 feet southwest of the tree, o separate all of the branches. The height is about 100 feet; the height of before it begins to branch, 12 feet; circumference at 4 feet above ground, 10 feet; t above ground, 10 feet 9 inches. The spread of the top is 35 or 40 feet. Looked ways the tree is not so symmetrical. The sketch is just as I made it on the . I thought I would not work over it at home, as I might change it by so

Very truly, as ever,

GEO. L. VOSE.

1 5, Plate IX, is from a photograph of a white pine tree in East
vi e, R. I., which is of the same general shape, but a smaller
shorter tree, still growing in a thick wood, its fellows, however,
smaller. The tree is about 70 feet in height, and 32 inches before
hes, the trunk sending out nine branches, the lowermost being
o feet from the ground.

t two examples we should judge that the terminal shoot only
royed by the weevil, while the lateral shoots survived, but grew
vertically than they would have done if the terminal shoot had
n injured, while their size became unnaturally large.

s comparatively easy to prevent this deformation of small young
n lawns and about houses or even on large plantations if the dis-
s combated in time; the wilting terminal twig should be examined,
grubs cut out. If a wash of Paris green were applied or a block
(olic acid soap securely placed in the crotch the grubs would be
yed or driven off. The time to apply the remedies is at the middle
e of July.

THE SPRUCE EPIZEUXIS.

(*Epizeuxis æmula* Hübner.)

hile in the Adirondacks, in June, 1884, at Beede's hotel, Keene
s, I beat from the spruce near the hotel two caterpillars, which I
lered to be without doubt leaf-rollers of the family *Tortricidæ*.
were in general appearance much like the Spruce Bud-worm (*Tor-
iferana*), though a little smaller, but with a well-marked dorsal
ateral line, which are more characteristic of Pyralid than Tortricid
ae.

, June 14 or 15, one of the caterpillars spun in the tin breed-
box cocoon covered with black scurf from the terminal twigs of
e.

ng the past season, in Maine, I collected another caterpillar on
, June 9, but failed to make a description of it or to notice the
of abdominal feet; the moth appeared June 24. From this it
pear that the normal food-plant of the caterpillar is the spruce.
are four species of this genus of moths in this country, the bet-
n one besides the present species being *E. americalis* (or *Helia
*. But their habits are strangely dissimilar, since Prof. C.
stated in the *American Naturalist* for October, 1883 (p.

1070), that *E. americalis* feeds in the larva state in the nests of a (*Formica rufa*). He also stated that so far as he knew this was th lepidopterous insect known to develop in ants' nests. This sta however, elicited from Lord Walsingham the following statements, lished in the same magazine (January, 1884, p. 81): "Noticing mention of *Helia americalis* as a myrmicophilous lepidopteron, I remind you of *Myrmicocela ochraceella*, Tgstr., which is found ants' nests. It is allied to the true *Tineæ*."

According to Guenée, however, the larva of *E. americalis* "li leguminous plants, as *Hedysarum*, *Melilotus*, *Pisum*, &c., and e corn, and is very destructive." He adds that the chrysalis is con in a cocoon spun between leaves.

DESCRIPTIVE.—*Larva*.—Body moderately thick, slightly tapering towards ca dull brown, with a well-marked darker dorsal and lateral line; the nili arranged much as in *Tortrix fumiferana*, which the larva somewhat re ..., warts not so conspicuous; the head is slightly paler than the body.

Pupa.—Body short and thick, rather fuller than usual, color pale horn-brown dominal spine broad and thick, subconical, rounded; vertically flattened abo beneath, the surfaces being somewhat convex, and the sides ridged above and At the extreme end of the spine are two long, slender bristles curved at the e the upper side of the spine are two bristles which converge and are closely con with the two at the tip. Length, 8mm to 9mm.

Moth.—Fore wings ash-gray, darker on the outer half, crossed by three black The first line, situated at the base of the wing, is short and represented by a costal mark, succeeded by a curved black line ending just behind the media not crossing the wing. Second line zigzag, situated on the basal fourth of the it begins as an oblique mark on the costa, edged within with white; behind, t makes two sharp teeth; on the median vein it points inwards, and again outw the submedian space. The third line is much broader and less wavy; it cur ward on the discal space, partly inclosing a large, diffuse, discal, ocherous Above this patch on the costa is a black mark bordered on each side with submarginal, fine, wavy white line. At the base of the fringe is a black int line. Hind wings ocherous gray, crossed by three diffuse, wavy, blackish lines panse of wings, 20mm to 22mm.

THE SPRUCE PLUME-MOTH.

(*Oxyptilus nigrociliatus* Zeller.)

The chrysalis of this Plume-moth was beaten from the branch the spruce June 23, at Brunswick, Me., under such circumstances lead me to believe that the larva feeds on this tree. In Europe no ber of the family to which it belongs (*Pterophoridæ*) is stated, so we have been able to ascertain, to feed on coniferous trees, so worthy of mention, though too infrequent to be of much signific The moth issued July 10, and has been named for me by Professo nald.

The larval skin occurred with the chrysalis; the head is of th mal form, pale in color, while the cast skin showed that the bod covered with long, dense hairs.

DESCRIPTIVE.—*Pupa*.—Like that of *Pt. periscelidactylus*, the thorax being ob truncated, and the body somewhat compressed. Thorax in front with six p long, curved, stiff hairs, those of the abdomen in two dorsal rows of five pairs, lateral row of short, stout spines; from each of the dorsal spines radiate four hairs; from the spines of the lateral row arise two hairs which are curled and ... with the longitudinal axis of the body. The wings extend to near the ...ne sixth abdominal segment. Color, pale green; wings and body whi Length, 7mm.

Moth.—Uniform dark brown, fore wings forked with four white ... third the largest and widest, the fourth linear, oblique, and extend... ...nd or hinder division of the wing; the latter with a white spot near t... ...es... ops of the fringe white, a black patch at the internal angle; hinder edge of th ...hite, apex blackish. Expanse of wings, 16mm.

THE PINE PHEOCYMA.

(*Pheocyma lunifera* Hübner.)

The caterpillar of this noctuid moth is of frequent occurrence on pine [illegible]ally the white pine and pitch pine, in Maine, where I have [illegible]or several years. In Northern New England the larva [illegible]through August into the first week of September, when it transforms into a chrysalis, the moth appearing May 10. I am indebted to [illegible] B. Smith for the identification of the species.

The caterpillar is, like nearly all those which live on trees, protected [illegible] observations of its enemies, such as birds, ichneumons, &c., [illegible] similarity in color to the bark of the twigs on which it often rests, [illegible] the reddish stripes are concolorous with the base of the needles

[illegible] caterpillars vary a good deal. Some are wood or horn brown, or [illegible] the body is decidedly reddish, with the longitudinal band more distinct than usual; some are green with white lines, but the warts and head as in the more usual varieties. They are closely similar to the larvæ of [illegible]*ptera* and *Catocala*.

THE EVERGREEN CLEORA.

(*Cleora pulchraria* Minot.)

The caterpillar of this pretty moth is of common occurrence on the spruce, fir, and hemlock. In certain years it is quite common, and was observed in greater abundance on spruce and firs along the road from the Glen House, White Mountains, to Jackson, N. H., than elsewhere. It is so common on these trees as to merit especial attention.

The caterpillars were observed in the White Mountains during the first week in July. They began July 18 to spin a loose, thin, open, slight yellowish cocoon among the leaves, the pupa state lasting about three weeks, the moths appearing August 14. On the coast of Maine it occurs on the hemlock, some of the caterpillars being without the usual black spots on the sides of the body. The moths are found flying in the woods through September. At Providence we have beaten the chrysalides out of hemlocks early in October, the moths appearing soon after. The green chrysalides, which are striped with white, are very pretty objects. They rest among the leaves in a loose network of yellow silk threads, retaining their hold by the curved hooks on the large spine (cremaster) at the end of the body. The caterpillar is a very pretty one, being yellowish, spotted with black on the head and body. It is similar to the larva of *Zerene catenaria*, but less conspicuously marked.

DESCRIPTIVE.—*Larva*.—Body moderately thick, of the same diameter throughout, smooth, with no warts, but somewhat wrinkled. Head of the same width as body, slightly wider than the prothoracic segment, and above slightly swollen on each side of the deep median suture; pale whitish, sometimes reddish brown, with five or six large black spots and smaller minute dots. Body whitish horn (testaceous, often reddish) with a yellowish tint. On the first segment are four dorsal black dots arranged in a square; on the second and third segments a single transverse row of four unequal [illegible]k dots, as also on the abdominal segments. A lateral band, yellow except near [illegible]ntures, below which on the sides of the body are four narrow, wavy, broken, dark [illegible]ines, arranged in two sets. Supra-anal plate with four black spots; anal legs of [illegible]dze, flesh-red spotted with black-brown. Thoracic feet pale flesh color, or [illegible]ith brown and dark at the tips. Body beneath pale flesh, with two dark, [illegible]s. Often on each side of the clear, reddish-brown back is a row of long, nar[illegible]—[illegible]—[illegible]—

distinct spiracles; the band is irregularly edged above and below with dark brown. Sometimes a narrow white medio-ventral hair-line is present, narrowly edged on each side with dark brown, and inclosed by the same reddish-brown tint as along the back. Length, 24mm to 30mm.

Pupa.—Body green, becoming usually brown; thorax green above spotted with brown, the wings and legs pea-green, with two subdorsal white stripes along the abdomen, and a lateral white stripe; beneath, four longitudinal brown stripes. Pupa often becomes brown, and the wings slashed with light brown, the antennæ and forelegs of the same color, while the middle and hind legs are white. The terminal spine is rather slender, long, ending in two long, large, excurved hooks; a pair of much smaller ones at their base, and two pairs on the sides, one pair on the sides near the base, and the other farther underneath. Length, 11mm to 15mm.

Moth.—With unusually broad, transparent wings, which are white or pale ash. Head deep yellow. Fore wings crossed by two black lines, the inner with four scallops, the outer line sinuous, scalloped, with a great curve outward between the subcostal and the third median venule. Opposite the discal dots are three acute, smaller scallops, all of equal size. Fringe whitish, distinctly checkered with black on the ends of the venules. Hind wings with a scalloped outer line, often obsolete toward the costal edge, varying in its distance from the outer edge; beyond this line the wing is darker than at the base. Expanse of wings, 33mm. Its range, so far as known, is from Maine and Canada to the Middle States.

THE FIR PARAPHIA.

(*Paraphia deplanaria* Guenée.)

We have three species of Paraphia, two of which feed in the larval state on coniferous trees, Mr. William Saunders having bred *P. subatomaria* from the pine, on which it feeds in early summer, the moth appearing late in June; the larva is not, however, known farther than that its color is brown.

The caterpillar of the present species was found June 23, at Brunswick, Me., on the fir; on the 27th it became a chrysalis, and the moth escaped about a week or ten days later.

DESCRIPTIVE.—*Larva.*—Body cylindrical; in color and appearance like a fir twig. Head rounded, somewhat bilobed; body with no humps. Supra-anal plate rounded, not pointed at the tip, with six hairs. Color reddish brown with a greenish tint. Head greenish, mottled, and finely spotted, especially on each side of the vertex, with reddish brown; a row of lateral irregular dark blotches. Length, 22mm.

Pupa.—Of the usual shape, but rather stout; dark tan-brown in color. Terminal spine (cremaster) large and stout, the surface corrugated at the base; ending in a fork, each branch of which ends in two excurved hooks. Length, 12mm.

Moth.—Fore wings subocherous, with a median whitish band, beneath ocherous. The male may be distinguished by its smaller size, by the wings being more ocherous, by the distinct discal dots, and by the rather distinct median white band on the fore wings. The female differs greatly from the male, being much larger and with the wings more serrate, the two inner lines more or less obsolete, the border of both wings being much darker than the inside of the wing, the border sometimes having a lilac tinge. From the female of *P. subatomaria*, it differs in its still smaller size, in having usually but one subapical spot, instead of three as is usually the case in the other species, and in the outer border of the wings being darker or more decidedly ocherous. The wings of the female are more deeply serrated than in the other species. Expanse of wings, 22mm to 35mm.

THE SPRUCE THERINA.

(*Therina fervidaria* Hübner.)

This common insect feeds in Maine on the spruce, as the pupa was found early in August, and the moth was disclosed August 21. The larva was, unfortunately, not described. Abbot bred it in Georgia from the *Ialepia diptera*, and from his manuscript sketches, preserved in the

f ston Society of Natural History, we prepared the fol-
on. The pupa is described from our own specimen.

—*Larva.*—Body cylindrical, smooth; head of the same width as the
lowish-green above, pale purplish below. Two fine, blackish, lateral
line above.
r slender, whitish gray, slashed and spotted with brown on the side,
o than in *Th. seminudaria;* head, thorax and wings nearly unspotted;
and bristles as in *Th. seminudaria.* Length, 12mm.

THE PINE THERINA.

(*Therina seminudaria* Walker.)

ve reared this moth from a caterpillar found feeding on the
at Providence, R. I., but failed to prepare a description of
It passed the winter in the chrysalis state, the moth emerg-
y.

TIVE.—*Pupa.*—Moderately slender, thorax spotted with brown, wings
d spotted with brown; abdomen with a dorsal and two lateral rows of ir-
, and the segments also surrounded by a circle of spots. Terminal spine
arge, not corrugated below, above coarsely pitted with more or less con-
ures, the end bearing two long, straight, stout bristles, a pair of small
the upper side near the end of the spine; a small pair beneath, and a
r, one on each side. Length, 13mm.

THE PINE AMORBIA.

(*Amorbia humerosana* Clemens.)

leaf-rolling moth was bred from the white pine in Maine, the
pearing in May. It is a large species of *Tortricidæ*, the fore
ith the costal edge full. The head, thorax, and fore wings are
ash, with dark specks, but with no distinct lines and markings.
re two whitish patches in the middle of the fore wings, on each
which are a few fine black specks; in the middle of the outer
f the wing is a whitish patch. There is a marginal row of fine
ts. The fringe is pale; the hind wings are pale-gray slate
panse of wing, 24mm. The larva was not described. It has
from the benzoin bush and the poison ivy by Mr. L. W.
The species ranges from Canada and Maine to Pennsylvania.

THE V-MARKED CACŒCIA.

(*Cacœcia argyrospila* Walker.)

th of this species is not uncommon, entering our houses at
ng July in Maine and Massachusetts. My specimens have
ly determined by Prof. C. H. Fernald.
widespread species was first described in this country by Mr. C.
nson, in 1869, under the name of *Tortrix furvana;* at nearly
e time or soon after I described it in the Massachusetts Agricult-
port for 1870 under the name of the V-marked Tortrix (*T. v-sig-*
, and remarked that Mr. F. W. Putnam had raised it in abun-
he cherry. In his account of this species Lord Walsingham*
t in California it occurred near San Francisco, May 19,
species also occurred about Mendocino in the middle of
far north as Mount Shasta in August. One specimen

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ions of Typical Specimens of *Lepidoptera Heterocera* in the Collection of
seum, part iv, London, 1879, p. 9.

emerged on the 21st of June from a pupa found a few days previously between united leaves of *Æsculus californica* (Nutt.), the Californian horse-chestnut.

In his Synonymical Catalogue of the Described *Tortricidæ*, Prof. C. H. Fernald states: "Professor Riley wrote me that he bred it on rose, apple, hickory, oak, soft maple, elm, and wild cherry." It thus appears to be a general feeder on our shade trees, living between the united leaves. It ranges from Maine, where it is common, to Georgia, Texas, and Missouri, while it is not uncommon on the Pacific coast.

The larva has not yet been fully described; unfortunately we did not make a detailed description of it, beyond noting the fact that the larva is green with a black head and prothoracic segment. It feeds on the oak early in June, as one caterpillar occurred June 11, when it l a chrysalis, the moth appearing June 23. Hence without much there are two broods, the caterpillar occurring late in summer turning chrysalides, and hibernating as such, the moth flying about in the and laying its eggs on the shoots, so that the larva may hatch w the leaves are unfolding and find its food ready and at hand. Th brood of caterpillars is found early in June, and the in Au and early in September. The moth is of the size and the common apple-leaf roller (*Cacœcia rosana*) and the cherry (*C. cerasivorana*), but differs in the particulars stated below; caterpillar is more like that of *C. rosana* than *C. cerasivorana*.

DESCRIPTIVE.—*Larva.*—Body green, with a black head and prothoracic segment.

Pupa.—Of the usual form and color, but rather stout; the end of the abdomen has an unusually large sharp spine, with two lateral and two terminal large, stout, curved setæ or stiff hairs. Length, 12mm.

Moth.—Head, palpi, and thorax, rust-red; fore wings, bright rust-red; a l median, rust-red, oblique band bent downward in the middle of the wing; on side are two yellowish-white costal blotches, the outer one usually triangula oblique, sending a narrow line to the inner edge of the wing; a similar line inside of the band. Outer margin of the wing yellowish white, with two fine red lines, the outer one at the base of the fringe, which is whitish yellow. wings pale yellowish slate color, as is the abdomen.

THE HICKORY ECCOPSIS.

(*Eccopsis permundana*, Clemens.)

The larva of this pretty moth has been found in Providence, R. I., to live on the leaves of the white-heart hickory (*Carya tomentosa*), which it folds, and when about to change to a chrysalis lines the fold with a layer of whitish silk. I have observed the caterpillars May soon as the leaves are unfolded. From the 2d to the 9th of Ju insects changed to chrysalides and the moths appeared on t same month. The life-history is then nearly as follows: laid the previous autumn on the twigs, the insect being probably do brooded, the caterpillars hatch out simultaneously with the o the leaves, living about a week or ten days in this state betw folded leaves or rolling them up sideways or from the apex to in the fold or roll thus made, which it lines with silk, it cha chrysalis, remaining about a fortnight in this state until during week in June, in Southern New England, it appears as a beautifully marked moth flying about and resting on the leaves.

In Illinois, according to Mr. Coquillett (Papilio, iii, 102), the caterpillar feeds on the Siberian crab-apple, the cultivated raspberry, wild blackberry (*Rubus villosus*), and hazel, while in Maine Professor Fernald has bred it on the Spiræa (see Comstock, Agricultural Report for 1880),

ett gives the following account of its habits: "Lives in a leaf om the apex to the base, or between two or three leaves fastened r with silken threads. Found a great many May 30." His speci- the moth were named by Prof. C. H. Fernald. Those which I re fresh, well-preserved specimens, and on submitting them to or Fernald for identification he wrote me that they were prob- *copsis permundana* (Clemens).

rtunately I did not make a description of my caterpillars, and re copy that of Mr. Coquillett,

IPTIVE.—*Larva.*—Body green, usually clouded dorsally with dull leaden; first brownish; head and cervical shield black or pale brownish; piliferous spots icles concolorous; anal plate unmarked. Length, 15mm (Coquillett).

—Of the usual shape and color, abdominal segments having two rows of ines, while the tip of the abdomen is three-toothed, there being two small nd a small median projection. There are also eight small, rather short, bristles utwards at the ends, of which four are situated below the median tooth, and situated near together on the side near but within the base of the lateral There are two or three other setæ on the side, but farther from the tip. 10mm.

—A rather large species, with the general color brown-ash and umber-brown. little paler than the thorax, the latter with three transverse darker lines Fore wings with three large umber-brown patches, the basal one oblique, ig from the inner edge of the wing and only reaching the median vein. A irregular, broad band sending two blunt teeth inwards on the inner side; r side with three acute teeth, one in front and a larger one behind the median . large, oval, umber-brown spot on the internal margin of the wing, and an- ge oblique one extending from a little below the middle of the outer edge y to the outer fourth of the costal edge, in its course contracting in width and g very narrow before reaching the costa, in which it slightly expands, form- of the small costal brown spots beyond the middle of the wing. The fringe : dusky in the middle. Hind wings dark slate color, as is the under side of rs of wings, as well as the abdomen, which, however, is paler at the end. Ex- wings, 18mm.

THE VARIEGATED ECCOPSIS.

(*Eccopsis versicolorana*, Clemens.)

species also feeds upon the leaves of the white-heart hickory *tomentosa*) in company with the foregoing species. The larva to eat the leaves when they are unfolding, and the moth appears middle of June. Unfortunately no notes were made on the cater- as they were confounded with the other species until the emer- of the moths showed that there were two species.

IPTIVE.—*Pupa.*—Slenderer than that of *E. permundana*, the end of the abdo- entate, with the eight bristles arranged as in the foregoing species, but much id longer. Length, 8mm to 9mm.

—Pale, greenish, umber-brown, with whitish patches. Palpi whitish to the ead dark between the antennæ, pale behind and in front. Fore wings olive dark patch at base, becoming paler towards the inner edge of the wing, with ecks, then becoming a pale, whitish, somewhat silvery band, crosses the wing. median, dark, olive-green patch; the outer scales raised and dotted with Beyond this patch are three light, squarish costal spots. An oblique olive- e passes from the outer margin just above the internal margin to the costa, g nearly obsolete before reaching the costa, but ending on the fourth costal n apical dusky spot. Hind wings dark slate, and fore wings beneath dark th lighter costal spots. Expanse of wings, 15mm.

THE WHITE-HEART HICKORY GELECHIA.

(*Gelechia caryævorella* n. sp.)

we have numerous species of this extensive genus of Tineid . pon our forest trees, none, we believe, have been recorded ue expense of the hickory.

The larvæ of the present species were found at Providence, R. I., feeding upon the young, freshly unfolded leaves of the white-heart hickory (*Carya tomentosa*), rolling them up. Within the roll the chrysalis was discovered from June 2 to 4. The insect remains about two weeks in this stage, the moths appearing in my breeding-box June 17 and 23.

The moth belongs to that section of the genus with moderately wide fore wings, which are oblong, and moderately pointed at the tip. Professor Fernald informs me that it is allied to *Gelechia bicostomaculella* of Chambers.

DESCRIPTIVE.—*Moth.*—Palpi very long, the third joint slender, one-half as long as the second; second joint with black specks; third black, but white at the tip. The fore wings broad, oblong. Head, thorax, and wings blackish, with whitish buff-yellow specks and dots. The fore wings are dark pepper and salt, with a row of five deep black spots along the middle of the wing, increasing in size towards the end of the wing; the basal spot minute; the third large, and sending a branch obliquely inwards to the costa; the fourth patch large, irregularly squarish; above it is a black square costal spot, next to a buff-white, distinct costal spot opposite another on the inner edge of the wing; the two spots are sometimes almost connected by a light line. The edge of the wing buff-white with black scales. Hind wings and abdomen slate-colored. Length of fore wing, 7^{mm}; width, 1.5^{mm}; expanse of wings, about 15^{mm} (0.60 inch).

THE WILLOW TERAS.

(*Teras viburnana* Clemens.)

The caterpillar of this common species is of the ordinary shape and green in color, occurring on the willow in Maine during August. The specimen we reared changed to a chrysalis August 19, remained in that condition a little over two weeks, namely, until September 7. The moth has been determined by Professor Fernald.

DESCRIPTIVE.—*Larva.*—Greenish.

Pupa.—Body slender; end of the abdomen flattened and excavated, with two large lateral hooks before the tip. Length, 8^{mm}.

Moth.—Head, thorax and fore wings rust-red. Head above and front of thorax deep rust-red, hinder edge of the thorax bright red. Fore wings rust-red, deeper on the costa; a dusky patch at the base; beyond, on the inner third of the costa, is a broad, paler, square spot, succeeded by a long, dark, deep reddish-brown patch, which extends to near the apex. The rest of the wing is clearer and paler, ash-colored, mixed with brick-red scales. In the middle of the wing on the inner third are two distinct, twin, fine black dots. Beyond are three black dots, forming an oblique line, extending from the median vein to a little beyond the middle of the hinder edge of the wing; a few scattered, black, fine dots near the outer edge of the wing. Fringe broad, reddish externally, dark on the basal half, and grayish on the inner angle of the wing; hind wings uniformly gray slate-colored; abdomen dark brown, paler at the tip. Expanse of wings, 18^{mm} (0.70 inch).

THE PURPLE WILLOW GRACILARIA.

(*Gracilaria purpuriella* Chambers.)

Late in August (the 20th) we found the caterpillar of this beautiful moth, which had turned over obliquely the tip of the willow leaf and securely fastened it to the under side of the leaf, thus making a triangular fold. The worm had eaten the parenchyma from the under (i. e., inner) side, leaving a mass of black castings. The worm soon transformed, remaining about two weeks in the pupa state, and the moth appeared September 19. The moth is a very beautiful creature, with a delicate body, wings, and legs. Our example was perfect, and agreed in all respects with Mr. Chambers' description, which is copied below.

however, describe the caterpillar. He remarks that it is
l to the European *G. stigmatella.*
(*Canadian Entomologist*, iv, 28) that "the larva mines the
willow (*Salix longifolia*) for a very short time; then, leav-
it rolls the leaves from the tip upwards into various forms
or helix of three spirals). * * * It frequently leaves
akes another, and, when ready to pupate, makes a dense,
nt web over it, upon the ground, not on the leaf, as in
ecies. The imago emerges in the fall, and most probably
." He again remarks (*l. c.*, v, 46): "The cone sometimes oc-
entire leaf; the apex of the leaf is bent over, so that the left
es the right one, to which it is fastened; then the leaf is
ly to the base, and the tip is used to close one end and the
, so that the whole leaf is utilized. Many of the mines,
are by no means so perfect." Chambers has also bred it from
eeding on the silver-leaf poplar, but, though not occurring on the
ng willow, it is common enough on many of our native willows.

PTIVE.—*Larva.*—Body of the usual cylindrical shape; no cervical shield.
ll, considerably narrower than the prothoracic segment. Head and body
greenish yellow. Only four pairs of abdominal legs, and these, with the
eet, are of the same color as the body. Length, 6mm to 7mm.
Pupa.—Very long and slender, so delicate as to scarcely retain its shape when the
th has left it.
Moth.—Violaceous, reddish, or brownish purple, according to the light. Face pale
olaceous, flecked with brownish purple. Antennæ brown, tinged with purplish,
intly annulate with white at the base of each joint; palpi pale purplish. The tri-
white spot at about the middle of the costa is nearly equilateral; its ante-
gin is a little concave, the apex reaching the fold, and it has four small spots
general hue situated in it upon the costa. Fringe bluish fuscous. Posterior
white at the tip and with a wide white band about the middle, and their
surface entirely white. Posterior tibiæ and inner surface of intermediate tibiæ
e. Tarsi pale grayish fuscous, faintly annulate, with white at the joints. Abdo-
n purplish fuscous, on a white ground. Expanse of the wings, half an inch (12.5mm).
Chambers.)

REPORT ON EXPERIMENTS IN APICULTURE.

By NELSON W. MCLAIN, *Apicultural Agent.*

UNITED STATES APICULTURAL STATION,
Aurora, Ill., November 17, 1885.

DEAR SIR: I have the honor to submit herewith my report of the experimental
rk done at this station.
In obedience to instructions received from you the 1st of June, 1885, I selected a
n suitable for an apicultural experiment station, at this place.
work attendant upon the beginning of any undertaking is considerable.
building of fixtures suitable for the accommodation of bees and for carrying on
perimental work, securing bees, and doing that which is necessary to be done in
blishing an apiary, consumed time. However, a number of interesting and valuable
nents have been undertaken and progress has been made.
desire to acknowledge my obligations to yourself for valuable aid and suggestion
d to all those who have kindly assisted me in my work, and especially the favor
n me by the publishers of the following apicultural journals for files of their
ble papers, namely:
American Bee Journal, Messrs. Thomas G. Newman & Son, Chicago, Ill.; *The*
Farmers' Magazine, Messrs. King & Aspinwall, New York City; *Gleanings in Bee*
Mr. A. I. Root, Medina, Ohio; *The American Apiculturist* (vols. 1, 2, and 3),
Silas M. Locke & Co., Wenham, Mass.; and to Messrs. D. A. Jones & Co.,
Ontario, Canada, publishers of *The Canadian Bee Journal.*
Yours, very truly,

NELSON W. MCLAIN,
Agent in Charge.

C. V. RILEY,
Entomologist.

ECONOMY IN THE PRODUCTION OF WAX.

Experience had taught us, in common with all progressive apiarists, that in the production of wax for honey-comb building there is serious prodigality. Much valuable time is lost and much energy is expended, which, in view of the shortness of the honey-producing season in nearly all parts of the United States, results in a serious reduction of the possible efficiency and honey-producing capacity of bees, and a corresponding curtailment of the profits possible to be realized from the industry.

To overcome this waste of time and prevent the large consumpt honey required for producing wax for comb-building, the honey foundation machine and the honey-extractor have been almost uni sally adopted by progressive bee-keepers.

As another step in economic methods for securing the best from the cultivation of bees, we have made some experiments in may be called wax-feeding or furnishing wax.

The price of bees-wax in the open market ranges from 20 to 35 per pound, according to quality, and varying with the supply mand. Estimates can easily be furnished to prove that the pro of every pound of wax costs the bee-keeper ten times the sum from its sale.

If account be taken of the loss resulting from having the ti energies of the bees expended in wax-production instead of ho duction at a season of the year when there is most imperative n uninterrupted and diligent activity in honey-gathering, and of the of the honey consumed in producing wax, and of the labor requi preserving and preparing the wax for market, it will readily that the production of a pound of wax costs the producer m the current prices realized. About 20 pounds of honey are co in producing 1 pound of wax.

If a method of management can be devised and introduced by w the loss sustained in wax-production and comb-building can b further reduced, a corresponding percentage will be added to the p of those engaged in the industry.

We observed that if pieces of new comb were exposed on a warm the bees would tear off pieces of the wax and carry them to their h for use in comb-building. We then put pieces of new comb in a shallow, square tin pan having a close-fitting cover, and having holes in the tom. This pan being placed on the cloth covering the comb f the hive, holes were cut in the cloth registering with the holes i bottom of the pan, thus affording a passage for the bees into the The heat arising from the bees produced a high temperature i closely-covered pan, keeping the wax plastic and easily worked. such auxiliary resources were furnished, comb-foundation was d out and completed with great rapidity, and this work appeared to b performed largely by the young bees, aided by the field bees at nigh the comb-building progressed more rapidly by night than by day. being no necessity for wax-producing, the working force labored out hindrance during the day in the fields, and with equal energy night in the hive. Whenever the space above the frames is not being used for superstorage this method of furnishing wax may be employed without inconvenience.

DEVICE FOR FEEDING SUGAR-SIRUP AND FOR OTHER PURPOSES.

We have used the same device with great satisfaction in feeding sugar-sirup. A rim of tin reaching within half an inch of the cover is sol-

d in the holes, through which the bees enter the feeder, and a raft
oat made of thin strips of wood supports the bees when taking their

re so devised a fixture for use in the brood-chamber in the
v ve, which serves a variety of uses and proves well adapted
purp es for which it is designed.
consists of a wooden frame of the size of those used for brood-
the strips of which it is made being three-eighths of an inch
2 inches wide. Parallel with the top bar of the frame I sus-
three tin troughs, one above another. These troughs are 1¾
wi and 2 inches deep, and the length corresponds with the in-
e of the frame. Beginning 1½ inches below the top bar, the
suspended, 1 inch apart, by means of a small screw from
ue of the end of the trough entering the side bar of the frame.
nrst trough next to the top bar has a partition, one-fifth being in-
to contain water, and the remainder is used to supply honey or
. The second trough is used to supply pure wax shavings, and
hird is used for supplying flour or meal as a substitute for pollen.
troughs should be painted and sanded inside and out, as bees
ily get a foothold on the smooth tin. The trough for food
led with floats to prevent the bees from drowning.
ixture, supplied with food, salty water, shavings of pure, bleached
, a flour, I place in the center of the colony as early in the spring
red to stimulate brood-rearing, in order that the colonies may
g in numbers when the blossoms appear. We use this device
supplying wax shavings in the body of the hive when surplus
being stored above the frames, and if floats are supplied for
gh it makes an excellent inside feeder when feeding sirup pre-
ory to winter. The wax used is clarified and bleached in the usual
d shaved with a sharp knife. If very thin comb-foundation
ow walls be used in the sections, a superior quality of comb
ly built.
ages to be gained by using such a device when building
the spring, or during the working season, when time is
, will be appreciated by those who give it a trial.

WINTERING BEES.

h of the different methods of wintering bees, whether in cellars,
ses, or upon the summer stands, has its advocates among experi-
and progressive apiarists. Success by any method depends largely
the proper observance of a variety of conditions. Failure to com-
with essential conditions brings failure by any method.
The lack of water during long confinement has been accredited with
ration as a prime cause of the frequent severe losses in win-
vation and experience suggest the inquiry as to whether as
s do not perish each winter from the lack of water as from the
d.
ern half of the United States bees are often confined to
ive continually from one hundred to one hundred and fifty days.
ly the suffering from thirst is intense, as is evidenced by the
g from frame to frame, visiting every comb and uncapping the
n search of water.
frequently observed these chips of cell capping distributed
y through the pile of dead bees in the bottom of the hive, and
ard, showing that the bees were suffering for water

when they began to die. Perishing from thirst day by day the c dwindles until, a mere handful being left, they succumb to the

Excessive thirst and prolonged low temperature cause what is "roaring in the hive." Disquietude from any cause induces e consumption; dysentery follows; death usually results. I have fr quently quieted roaring in the hive and restored the bees to their mal condition of quietude by supplying water.

For furnishing the bees water in winter without disturbing the ter, across the tops of two comb-frames, and above the intervening between, we place a block, 3 inches or 4 inches square and 2 thick, through which is a 2-inch auger hole. In the hole in the blo placed a sponge dipped in water and squeezed out sufficiently to p vent the water from dropping on the bees below. The blanket replaced, the heat from the bees prevents freezing, and usu ly sponge will be sucked dry in twenty-four hours.

The sponge should be thoroughly rinsed before refilling. The w given the bees should be lukewarm and brackish. The salt is rel by the bees and acts as a corrective. If cushions are used above frames the sponge may be suspended between the frames above cluster by means of a fine wire. A mild day should be selected watering the bees. If after the bees have been confined fifty s sponge full of water be given every thirty or forty days durin stay in winter quarters, in many cases valuable colonies will be which would otherwise be lost. Whether the bees are to be winter indoors or on summer stands, the arrangement of the hives should c template the practicability of giving water.

BEES VS. FRUIT.

For the purpose of testing the capacity of bees, under excepti circumstances, to injure fruit, we built a house 16 feet long by 10 wide, and 8 feet high at the corners. Large doors were hung in end, and a part of the siding on each side was adapted to be r on hinges. Screen doors were hung on the inside of the outer doors wire cloth covered the openings on the side where the siding w The house is entirely bee-proof. When the sides are raised up, outer doors opened, the temperature and light in the house is tially the same as outside. Along the sides of the house we built upon which fruit was placed so that the rays of the sun might strik different varieties in different stages of ripeness, from green ripe. Plates of ripe peaches, pears, plums, grapes, &c., were the shelves; clusters of different kinds of grapes, green and ripe, and imperfect, and such as had been stung by insects, were su from the rafters and cross-ties of the house.

The 1st of September we removed three colonies of bees fr the hives, carefully and quickly, so that they would carry very little with them when transferred from one hive to another. Two of the c nies were hybrid bees, and one Italian. These colonies were hiv empty combs, and placed in the house with the fruit. A wood was put in the house, and for a number of hours each day a high perature was maintained. The physical conditions which would o narily prevail in nature during a protracted and severe drought artificially produced and steadily maintained.

The bees were brought to the stages of hunger, thirst, and starv ion. The house was kept locked, and we carried the key.

Every inducement and opportunity was afforded the bees to

hunger and thirst by attacking the fruit exposed. They daily visi- the fruit in great numbers, and labored diligently to improve the remaining source of subsistence. They inspected and took what vantage they could of every opening at the stem or crack in the epi- mis or puncture made by insects which deposit their eggs in the skin grapes. They regarded the epidermis of the peaches, pears, plums, other fruits having a thick covering simply as subjects for inquiry investigation, and not objects for attack. If the skin be broken or they will, in case of need, lap and suck the juices exposed. ne ne was also true of the grapes if the skin was broken by violence on account of the fruit becoming overripe; the bees lapped and ed the juices from the exposed parts of grapes and stored it in the for food. They made no attempt to grasp the cuticle of grapes wi th r mandibles or with their claws. If the grapes were cut open from overripeness the bees would lap and suck the juice from exposed segments of the grape until they came to the film separat- the exposed and broken segments from the unbroken segments. gh and beyond the film separating the segments they appear to be able to penetrate. I removed the outer skin from many grapes of ent kinds, taking care not to rupture the film surrounding the pulp. these were exposed to the bees they continued to lap and suck es from the outer film until it was dry and smooth as was the between broken and unbroken segments. They showed no dispo- o use their jaws or claws, and the outer film as well as the film een broken segments remained whole until the pulp decayed and ned up.

After continuing the test for thirty days, using such varieties of fruit could be obtained, we sent to Michigan for varieties not obtainable e. Through the kindness and favor of the president of the Michi- Horticultural Society, Mr. T. T. Lyon, of South Haven, Mich., we ed twenty varieties of grapes, which arrived in excellent condition. another colony of Italian bees was then placed in the house with those ady confined for forty days, and the twenty varieties of grapes were osed upon plates and suspended from the rafters as before. The litions naturally prevalent during a severe and protracted drought ere again produced, and the test again continued for twenty-five days. he result was simply a repetition of the former test. The bees showed o more capacity or disposition to offer violence to one variety of grapes han another. No more attention was given the thin-skinned varieties n the thick-skinned. As long as the skin remained whole they did ot harm the grapes. When the skins were broken by violence, such by cutting or squeezing, the juices exposed were appropriated. The ent of damage the bees could do to grapes burst from overripeness epended on the extent of the rupture in the film surrounding the pulp. wide rupture may be made in the epidermis, or it may be removed, if the film is unbroken the pulp remained whole. The film seldom sts until the grape is about to decay, or has begun to decay, and the grape is of little value.

In order to determine the size of the opening necessary to be made order that bees might injure grapes, we punctured the cuticle of grapes in several bunches with cambric needles of various sizes. puncture made with the point of medium-sized needles produced no t. Neither does the puncture made by the sting of insects when ting until the blister appears and decay progresses with the de- nt of insect larvæ. I found that I might pass a medium-sized through a grape, from side to side, and bees could obtain no

juice except that oozing from the puncture. Many erroneously suppose that bees sting the grapes. Bees never sting except in self-defense or in defense of their homes from real or imaginary danger.

At times when bees could gather nothing in the fields we saturated clusters of grapes with honey and suspended them in front of the hives in the apiary, and from branches of trees and grape-vines near by. Other clusters dipped in honey and sirup were hung in the house. The bees thronged upon the grapes until the clusters looked like little swarms hanging to the vines and limbs. They lapped the grapes until the skins were polished perfectly smooth and shining, like the inside skin of an onion, and no taste of sweet could be detected by touching the tongue to the grape. The skins of the grapes were left intact.

Bees, like some animals of a higher order, seem to enjoy stolen sweets better than any other. Taking advantage of their propensity to steal and despoil, we placed combs containing honey in an unoccupied hive and permitted the bees in the apiary to steal the honey and such portions of the combs as they could appropriate. We then suspended instead of the despoiled combs clusters of grapes dipped in honey. The bees attacked with desperate earnestness, apparently determined to literally go through those grapes. The clusters were left hanging for a day or two, until the bees had entirely deserted the hive, and examination showed the grapes to be as sound as when placed there and the skins polished smooth and clean as before.

We then punctured the grapes of several clusters by passing a darning needle through the berries from side to side, and hung them in the house near the hungry bees. They sucked the juices from the broken segments as far as they could insert their tongues into the wound, leaving a depression near the puncture, and the remainder of the pulp was left whole.

The instinct of bees impels them to remove everything useless or strange from their hive. They will labor harder to remove any object which is useless or offensive than for any other purpose. After passing a darning needle through some of the grapes in several clusters of different varieties, we suspended these clusters from the top of comb frames by using fine wire, and placed them in the center of strong colonies of both hybrids and Italians. The juice was extracted from the punctured segments as before, and the perfect grapes hung undisturbed for fifteen days. They appeared to have kept better hanging in the hive than they would have kept on the vines.

The evidence then shows that bees do not injure perfect fruit. We have observed that they give no attention to the puncture and blight caused by the oviposition of other insects, until after the larva is hatched and decay has set in, and then only in cases of extremity. The circumstances under which bees appear to be able to injure grapes are very exceptional. That they will not molest or even visit grapes when it is possible to secure forage elsewhere is certain. It also appears certain that they never attempt violence to the skin of grapes. The capacity of bees to injure overripe grapes is limited by the extent to which the juice and pulp are exposed by the bursting of the film. If the film is only slightly burst the bees can do but little injury. If the progress of decay has caused a wide rupture in the film the bees more readily appropriate the juice. If overripeness and decay have exposed the pulp of grapes to such an extent that bees can damage them seriously, the bees should be confined to the hive (unless the weather be excessively hot), and the grapes should at once be gathered, for from this stage the progress of decay is rapid. Confinement to the hive for a short time, while the over-

e grapes are being gathered, would result in no loss, and the bees would prevented from gathering the grape juice and storing it in the hive. es confined to their hives in warm weather must always have ample ventilation, and should be liberated and allowed to fly half an hour re sunset each day during the term of their confinement. The ex- re use of grape juice often produces inebriety. In the case of es it produces diarrhea. After grapes have arrived at the stage of erripeness and decay in which it is possible for bees to injure them, d the circumstances are so exceptional as to cause the bees to seek food, it would be advantageous to the grape-grower to secure his apes from the ravages of decay, and advantageous to the bee-keeper secure his bees from the ravages of disease.

The following-named varieties of grapes were used in making these : The Niagara, Delaware, Roger's No. 10, Roger's No. 14, Roger's 15, Roger's No. —, Taylor, Ives, Lady, Hartford, Martha, Concord, hern Muscadine, Vergennes, Brighton, Pocklington, Worden, Isa- I na, and Syrians from California, and three other varieties the or which I did not learn.

. Richard Rees, a florist and horticulturist of many years' experi- n the Eastern and Western States, informs me that he has very lly observed the effect of bees upon flowers and fruits in the or- , garden, and greenhouse. He regards their presence as wholly le and altogether beneficial. During a term of four years he charge of a large conservatory and garden in this city. At times ad as many as fourteen different varieties of exotic grapes in bear- n the conservatory, and from 2 to 3 tons of ripe grapes hanging vines at once. A large apiary was located near by, and late in all and early in spring the flowers and fruits in the conservatory ted by the bees in great numbers. The grapes were unmolested, e bees aided in fertilizing the flowers. He says that he has had e ex ience in grape-growing in vineyards, and that he has never y damage or loss resulting from bees, and that when grapes ju from overripeness, or decayed and blighted by the hatching ct larvæ, to such an extent that bees can appropriate their juices, are of little, if any, value. He has never kept any bees, but he ls them as being of great service to floriculturists and horticult- on account of the service rendered in fertilizing blossoms.

ARTIFICIAL FERTILIZATION.

Since we began this work we have given much thought and labor to iments in methods of artificial fertilization.

o other branch of apicultural experiment possesses the same scien- interest or practical value to the industry of bee-keeping.

ver since the art of bee-keeping began to be practiced upon scientific ples, the value of exact knowledge and perfect control of the pro- of fecundation has been recognized.

In 1846 an able German apiarist wrote: "If it were possible to as- ain the reproductive process of bees with as much certainty as that our domestic animals, bee culture might unquestionably be pur- with positive assurance of profit, and would assume a high rank the various branches of rural economy."

In a current number of one of the most progressive bee journals, ent writer on apiculture says: "The apiarist who finds out a , and certain method of controlling fecundation as it is com- the animal kingdom, will confer a great and lasting blessing

upon bee-keepers, and be the means of advancing the profession a long way towards perfection." Realizing the difficulties to be overcome, there was little encouragement to expect success. However, all progress "is usually the slow outgrowth of repeated trials," and "failures precede successes."

Various methods and expedients have been adopted for securing the fertilization of queens in confinement, none of which have proved satisfactory.

During the past two years reference has occasionally been made in apicultural papers to a process of fecundating queens while in the larva and the pupa or nymph stage of development, by crushing drone larva upon the queen larva, or by opening the cell and introducing crushed drone larva upon the nymph queen. In a few instances experimenters have reported that the practice has been successful, and that queens thus treated have begun laying fecundated eggs in from one to two days after leaving the cell.

In each of the reported cases some important fact in the evidence tending to establish the genuineness of the claim to success seems to have been wanting or doubtful. In consequence these reports have been received with reserve and often with ridicule.

For putting these claims to the test, we caused a number of queen cells to be built, and just before the cells were capped I squeezed the contents of the generative organs of nymph drones upon the larval queens. The bees removed the larvæ and destroyed the cells. After other queen cells were capped we opened them by making a horizontal incision at the base of the cells, and another at right angles down the side of the cell, and laid back a part of the side, exposing the queen pupa. Through the opening in the cell we squeezed the liquid contents of the generative organs of imago drones upon the pupa queens. The sides of the cells were then replaced and sealed with melted bees-wax and rosin. These cells were placed in nursery cages and hatched in queenless nuclei colonies. These queens were liberated in nucleus colonies after their wings were clipped. Upon being hatched they resembled fecundated laying queens more than virgin queens. The treatment they received from the bees and their action upon the combs was that of fecundated rather than that of virgin queens. Repeated experiments, however, failed to produce a queen capable of laying fecundated eggs. Still, the fact that the treatment given the embryo queens had to such an extent changed their physiological characteristics was suggestive. From the analogy between the animal and vegetable kingdom where ripe seed is known to grow better than unripe, it seemed more than probable that the contents of the generative organs of a mature drone would have more virility than those of a drone larva or pupa.

That the active principle in the fluid contained in the procreative organs of the drones attains a degree of activity at a very early stage in their development is evident from the effect produced by exposing the larval queens to its influence. Continuing the experiment we caused more queen cells to be built. Removing the testes and seminal sack from mature drones with a pair of pliers, the contents were pressed upon the larval queens. The bees removed the uncapped larvæ as before. Most of the pupa queens so treated and placed in nursery cages for hatching died in the cell after assuming the imago state and after being partly colored. We hope to be able yet to discover what principles and practice are essential to success which seems possible, for many possible opportunites remain untried. While possessing possibilities of the greatest interest and value to the embryologist and entomolo-

doubtful whether a demonstrated method of what may be henogenetical fecundation would possess the essentials of and permanence in such a degree as to make the method serv- o bee-keepers. It remains to be tried whether a sufficient num- tive spermatozoa may be received into the spermatheca of queens the larva, pupa, or imago state to render them serviceable for ticable purpose, even if some of the reported successes were ailing to succeed by these methods it appears more reasonable best time to fecundate a queen is when she wants to be fecun- r when orgasm appears. Orgasm takes place in from five to ys, usually in five days, after the queen leaves the cell, and s for eight or ten days, and a few instances are reported where ave been fertilized as late as twenty-three days after leaving the

orgasm takes place the generative organs of the queen are xcited and much distended. We confined a queenless colony hive and gave them a queen-cell which had not been disturbed aturing, and allowed the queen to hatch. When the virgin queen days old orgasm occurred, and on the evening of the seventh emoved her from the hive and placed drops of the male sperm open vulva as she was held back downwards, by gently grasp- horax between the thumb and forefinger. The instant the male as pressed from the testes and seminal sack of a mature drone excited and distended vulva, it was curious to observe the ef- he action of the abdomen and vulva resembled that of young ile being fed. There was the reaching up after the seminal d an action of the parts resembling the opening of the mouth llowing food. As much seminal fluid as could be obtained, by rfect method employed, from three or four drones, was utilized lily absorbed by the queen, after which her wing was clipped and dropped on a frame covered with bees and returned to the hive, bees were liberated. Up to this time her appearance and ac- that of a virgin queen. The next morning, twelve hours after e to the seminal fluid, her abdomen was distended, and her ap- and action in all respects was that common to fertile, laying She was moving about slowly over the combs and peering into , and in twenty-four hours afterward she had 400 or 500 eggs r cells. We watched the development of larvæ from those n due time worker larvæ appeared, and at this date, Novem- vorker bees in considerable numbers are being hatched. We red two queens from the eggs laid by this artificially fecundated queenless colonies, and as soon as they were hatched I clipped gs, and when orgasm appeared they were treated as before de- and in three days one laid a few eggs in worker cells. The other appearance and action of a fertile queen, but has laid no eggs, lateness of the season forbids advantageous continuance of the ents.

realizing the necessity for exactness and certainty in all de- fore tabulating the results of any method so revolutionary, I avored to effectually guard against all possibility of the test tive. Instances have been reported where fecundation had ce in the hive; but as many examinations proved that there urones in these hives, and judging from the lateness of the sea- ity of the weather, probably none in the country, except a been preserved in a queenless nucleus colony by fre- ng the bees and confining them in the hive, and from the

further fact that the experiments were conducted when few bees a time attempted to leave the hive, and from the fact that these qu wings were clipped when they were removed from the nursery c can confidently assert that fecundation by the natural method u take place. These later experiments in fecundation have been ducted through the months of October and November, during th valence of most unpropitious weather, and those acquainted wit habits and instinct of bees will understand the difficulties under we have had to labor. With the return of spring and the advant conditions attending the normal season for breeding, and after u ering and adopting better methods and devices for appropriatin depositing the seminal fluid, we are hopeful that the fecundati queen bees may be controlled with the same ease and certainty as dation is regulated among all domestic animals, and that the pe of the breeding stock in the apiary will be as readily traced and as h valued as is the recorded pedigree of the illustrious scions of the and the aristocratic families of the American Herd Book.

We regret that the lateness of the season prevents the furthe tinuance of these tests now, as we fully appreciate the necessity o ing the evidence in support of the facts set forth on the incont basis of continued and often-repeated succeseses, and not upon th cess obtained in two individual cases. However, the fact that I succeeded in producing queen bees of two generations which artificial means been made to perform the normal functions of u fecundated queens, seems to furnish ground to hope that this has passed from the plane of experiment to the position of p Other methods for controlling fecundation also remain to be

BEE FORAGE.

Our time has been so closely occupied with the experiments re upon that we have had little time for other important work cover your instructions. Considerable information has been gathere tabulated concerning the habits and value of different varieties of h producing plants for bee forage, with the view of lengthening the ing season by cultivating such as bloom successively from spring late in the fall of the year.

IMPROVED RACES.

Some preliminary steps have also been taken in the matter of sec for importation some races of bees reported to possess valuable c teristics, that their value may be tested, in their capacity as a sp or when properly crossed with races already introduced.

IMPORTANCE OF APICULTURE.

As the economic importance of this industry is more generall zed, a wide-spread and growing interest is manifested in this neglected branch of rural husbandry. The lack of practical know is the main hindrance now existing in the way of the very g adoption of this pursuit among agriculturists, as nearly all parts United States are well adapted to profitable bee-keeping.

An idea of the present importance of this industry can be g from the following figures, taken from the report of the statis of the Northwestern Society of Bee-Keepers for 1884. He says:

cording to conservative estimates we have now a total of three millions of colonies of bees, which annually yield 120,000,000 pounds of honey. The value of the annual product, at an average of 15 cents per pound, would be $18,000,000."

The estimated annual product ranges from $15,000,000 to $20,000,000, nd the annual product of wax is about $1,000,000 in value.

Not more than 8 or 10 per cent. of those favorably situated for the ivation of bees are engaged in the pursuit. If even one-half of 'orably situated were so engaged, the annual product would ıau low $75,000,000 or $80,000,000 in value.

ıhe United States imported 2,400,000,000 pounds of sugar, at a cost of $94,923,500, in the year 1884.

A large percentage of these imports do not bring with them a character above suspicion. Instead of being importers we should be exporters of sweets, with the balance largely in our favor. Instead of paying their for the vile adulterations of foreign importations, our agricultur- ı snould gather the pure and wholesome nectar annually wasted in r own fields.

degree of skill necessary to engage successfully in the cultivation s and the production of honey is not greater than that required in keeping a dairy and producing good dairy products. The difference is in kiud, not in degree, of skill, and one is as easily acquired as the other.

That reliable reports concerning this industry may be funished in the bulletins and annual reports of the Department of Agriculture is earnestly wished for by all progressive bee-keepers.

Reports giving the number of colonies in the several States and Territories on the 1st day of June, and crop reports of apiarian products the 1st day of August and the 1st day of October of each year, would be of very great value.

The facilities possessed by the Department of Agriculture, through correspondents, furnishes the best means for obtaining reliable ics and crop reports. That such facts and statistics may be fur- ed in the bulletins and reports of the Department is earnestly ired.

[NOTE.—The "Notes of the year," referred to in the introduction, are excluded by he limit as to space allowed for this report.—C. V. R.]

EXPLANATION TO PLATES

TO REPORT OF ENTOMOLOGIST.

e figures are enlarged the natural sizes are indicated in hair-lines at side, unless already indicated in some other way on the plate.

EXPLANATION TO PLATE I.

THE PERIODICAL CICADA.

(Original.)

1.—Pupa of *Cicada septendecim* as it arises from the ground, side view.

2.—Pupa of *Cicada septendecim* as it arises from the ground, dorsal view.

3.—Pupa of *Cicada septendecim* as it arises from the ground, with the forming Cicada beginning to issue through a rent along the middle of the thorax.

4.—Forming Cicada in the straight or extended position.

5.—Forming Cicada in the hanging position, lateral view.

6.—Forming Cicada in the hanging position, ventral view.

7.—Forming Cicada in the clinging position, lateral view.

8.—Forming Cicada, dorsal view, with the wings beginning to inflate.

9.—Forming Cicada in the flat-winged position.

10.—Forming Cicada in the roof-winged position, and final colors becoming fixed.

11.—Side view of complete Cicada, with final coloring.

EXPLANATION TO PLATE II.

SILK CULTURE.

(After Pasteur.)

1.—Silk-worms which have died from flaccidity after mounting—reduced.

2.—Anatomy of the chrysalis—enlarged twice.

3.—Joint of silk-worm, showing *pébrine* spots in contrast to an incised wound—enlarged six times.

4.—*a*, worm with *pébrinous* spots just appearing; *b*, same, more advanced—enlarged twice.

EXPLANATION TO PLATE III.

SILK-WORM DISEASES.

(After Pasteur.)

FIG. 1.—Chain ferment of flaccidity—enlarged 350 diameters.

FIG. 2.—Corpuscles of *pébrine*. (Same scale.)

EXPLANATION TO PLATE IV.

EGG-PRODUCTION.

FIG. 1.—Cell or bag for egg-laying. (After Roman.)

FIG. 2.—Method of clamping bags. (Original.)

FIG. 3.—Constricted cocoon of fine texture. (Original.)

FIG. 4.—Non-constricted cocoon of coarse texture. (Original.)

EXPLANATION TO PLATE V.

THE PERIODICAL CICADA.

FIG. 1.—*a*, recent puncture, front view; *b*, same, surface removed to show arrangement of eggs, from above; *c*, same, side view; *d*, egg cavity exposed after eggs are removed, and showing the sculpture left by the ovipositor—all enlarged. (Original.)

FIG. 2.—*a*, twig showing recent punctures, from front and side, and illustrating manner of breaking; *b*, twig showing older punctures, with retraction of bark, and more fully displaying the arrangement of fibers—natural size. (Original.)

FIG. 3.—Twig showing scars from punctures after second year—natural size. (After Riley.)

FIG. 4.—Newly hatched larva—greatly enlarged. (After Riley.)

EXPLANATION TO PLATES.

EXPLANATION TO PLATE VI.

FIG. 1.—*The Periodical Cicada:* A, ♂ of typical form—natural size; *c*, *d*, genital hooks—enlarged: *g*, singing apparatus—natural size: B, ♂ of the small form (*cassinii*)—natural size; *e*, *f*, genital hooks—enlarged. (After Riley, and Hagen.)

FIG. 2.—*Dermestes vulpinus: a*, egg; *b*, *c*, larva lateral and dorsal view; *h*, pupa, ventral view: *k*, beetle—enlarged: *d*, dorsal view of one of the middle joints of larva denuded to show spines and tubercles; *i*, ventral view of tip of abdomen in ♂ beetle: *e*, head of larva; *f*, left maxilla of same, with palpus; *g*, labium of same, with palpi—enlarged. (Original.)

FIG. 3.—*Eurycreon rantalis: a*, larva; *d*, chrysalis—twice natural size; *f*, moth—slightly enlarged; *b*, side view of middle joint of larva; *c*, top view of last joint of larva; *e*, cremaster or anal tip of chrysalis—greatly enlarged. (Original.)

EXPLANATION TO PLATE VII.

FIG. 1.—*Agrotis messoria: a*, larva; *b*, moth—natural size. (After Riley.)

FIG. 2.—*Diplosis nigra: a*, larva seen from above: *b*, same, from side—enlarged: *d*, last joint of larva, from above: *c*, head of larva, from above: *e*, "breast-bone" of larva—all greatly enlarged. (Original.)

FIG. 3.—*Diplosis nigra: a*, adult female, from side; *b*, genitalia of male, from side; *c*, pupa, from side—all much enlarged; *d*, antenna of male: *e*, antenna of female—still more enlarged. (Original.)

FIG. 4.—*Diplosis nigra:* Genitalia of male, from above—greatly enlarged. (Original.)

FIG. 5.—*Anthonomus musculus:* Spray of strawberry, showing beetles at work—natural size. (Original.)

FIG. 6.—*Anthonomus musculus:* Adult, enlarged. (Original.)

EXPLANATION TO PLATE VIII

DESTRUCTIVE LOCUSTS.

(Figs. 1 and 5, original; 2, 3, and 4, from Second Report U. S. Entomological Commission; 6 and 7, from First Report U. S. Entomological Commission.)

FIG. 1.—*Melanoplus devastator:* large ♂ from California, 1885—natural size.

FIG. 2.—*Melanoplus devastator:* small ♀, Reno, Nev., 1880—natural size.

FIG. 3.—*Melanoplus devastator:* large ♀, Redding, Cal., 1880—natural size.

FIG. 4.—*Melanoplus devastator:* ♂, Fort Keogh, Montana, 1880—natural size.

FIG. 5.—*Melanoplus devastator: a*, anal characters of ♂, from above; *b*, anal characters of ♂, from the side; *c*, anal characters of ♂, from behind—much enlarged.

FIG. 6.—*Melanoplus spretus: a*, anal characters of ♂, from above; *b*, anal characters of ♂, from side; *c*, anal characters of ♂, from behind—much enlarged.

FIG. 7.—*Melanoplus atlanis: a*, anal characters of ♂, from above: *b*, anal characters of ♂, from side; *c*, anal characters of ♂, from behind—much enlarged.

EXPLANATION TO PLATE IX.

THE WHITE PINE WEEVIL.

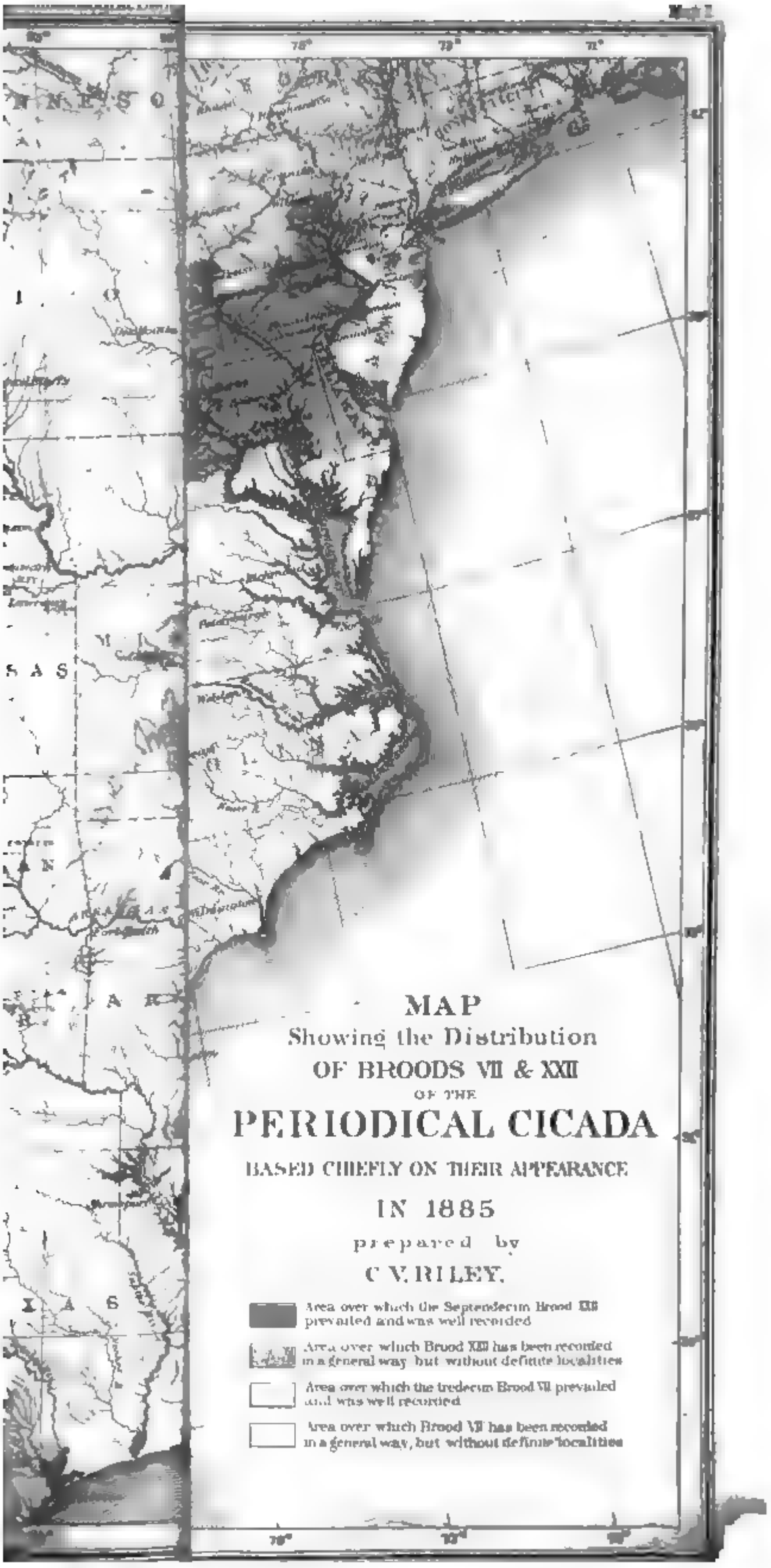
FIG. 1.—*a*, larva, from side; *b*, pupa, from beneath; *d*, beetle, from above—all enlarged. (After Packard.)

FIG. 2.—*a*, twig showing burrows of larvæ in heart-wood and sap-wood (original); *b*, twig showing pupa cells from the outside, and cut away to show interior.

FIG. 3.—*a*, dwarfed tree with a single bent shoot; *b*, dwarfed tree with two shafts. (Original.)

FIG. 4.—Deformed tree at Brunswick, Me. (from a drawing by Prof. G. L. Vose).

FIG. 5.—Deformed tree at East Providence, R. I. (from a photograph).


MAP
Showing the Distribution
OF BROODS VII & XXII
OF THE
PERIODICAL CICADA
BASED CHIEFLY ON THEIR APPEARANCE
IN 1885
prepared by
C V. RILEY.
Area over which the Septendecim Brood XIII prevailed and was well recorded
Area over which Brood XIII has been recorded in a general way but without definite localities
Area over which the tredecim Brood VII prevailed and was well recorded
Area over which Brood VII has been recorded in a general way, but without definite localities

EXPLANATION TO PLATES.

EXPLANATION TO PLATE VI.

FIG. 1.—*The Periodical Cicada:* A, ♂ of typical form—natural size; *c*, *d*, genital hooks—enlarged: *g*, singing apparatus—natural size: B, ♂ of the small form (*cassinii*)—natural size; *e*, *f*, genital hooks—enlarged. (After Riley, and Hagen.)

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FIG. 4.—*Diplosis nigra:* Genitalia of male, from above—greatly enlarged. (Original.)

FIG. 5.—*Anthonomus musculus:* Spray of strawberry, showing beetles at work—natural size. (Original.)

FIG. 6.—*Anthonomus musculus:* Adult, enlarged. (Original.)

EXPLANATION TO PLATE VIII

DESTRUCTIVE LOCUSTS.

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FIG. 4.—*Melanoplus devastator:* ♂, Fort Keogh, Montana, 1880—natural size.

FIG. 5.—*Melanoplus devastator:* *a*, anal characters of ♂, from above; *b*, anal characters of ♂, from the side; *c*, anal characters of ♂, from behind—much enlarged.

FIG. 6.—*Melanoplus spretus:* *a*, anal characters of ♂, from above; *b*, anal characters of ♂, from side; *c*, anal characters of ♂, from behind—much enlarged.

FIG. 7.—*Melanoplus atlanis:* *a*, anal characters of ♂, from above: *b*, anal characters of ♂, from side; *c*, anal characters of ♂, from behind—much enlarged.

EXPLANATION TO PLATE IX.

THE WHITE PINE WEEVIL.

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FIG. 4.—Deformed tree at Brunswick, Me. (from a drawing by Prof. G. L. Vose).

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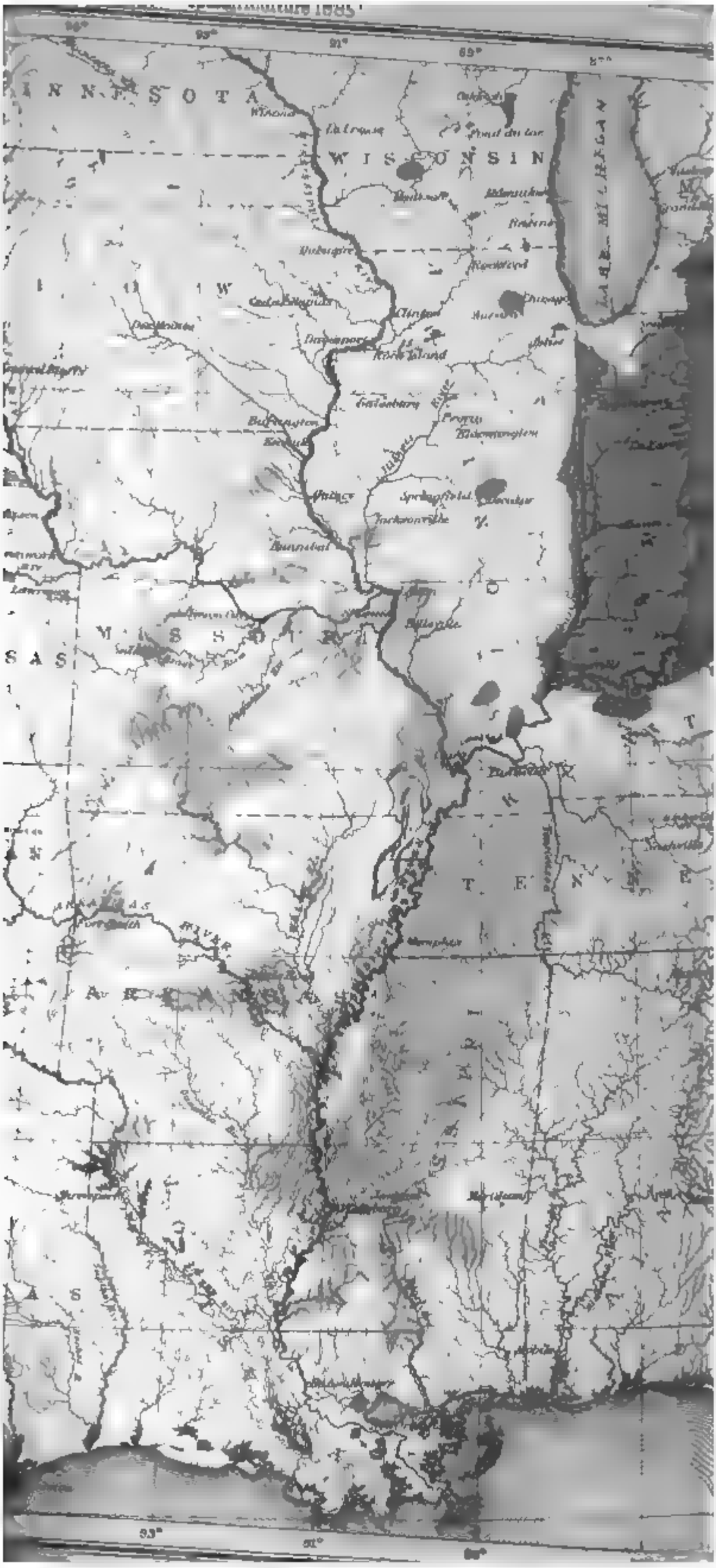


WISCONSIN
LAKE MICHIGAN
Dubuque
Clinton
Rock Island
Galesburg
Springfield
Jacksonville
Bunnibal
Belleville
Memphis
Meridian
Mobile

TRANSFORMATION OF CICADA SEPTENDECIM

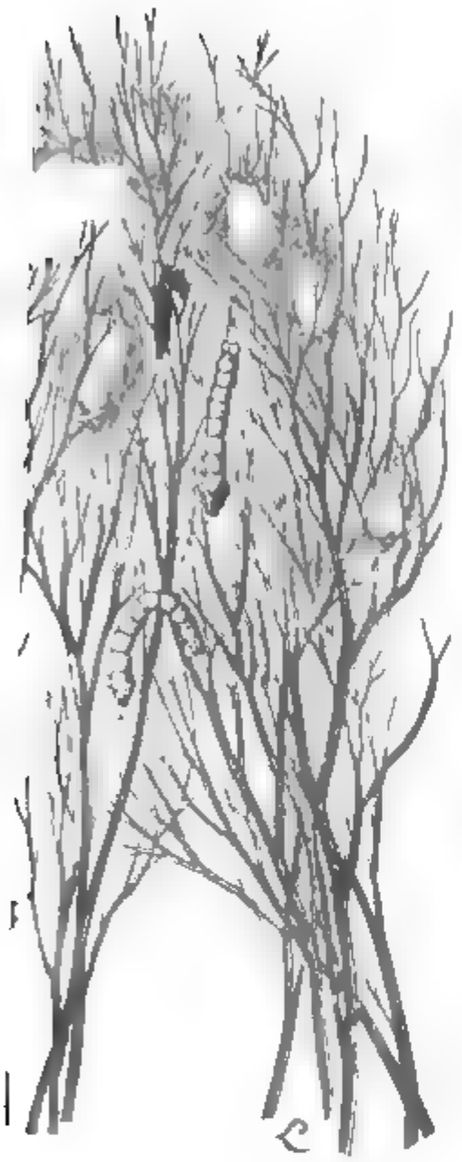


Fig. 1.

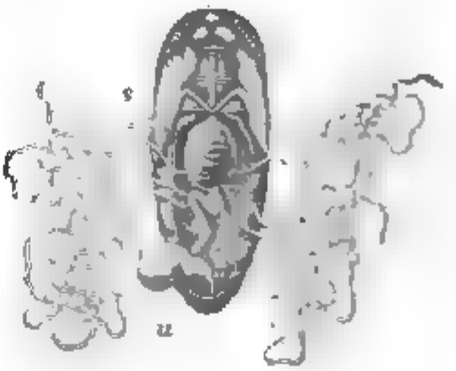


Fig. 2.

Fig. 3.

Fig. 4.

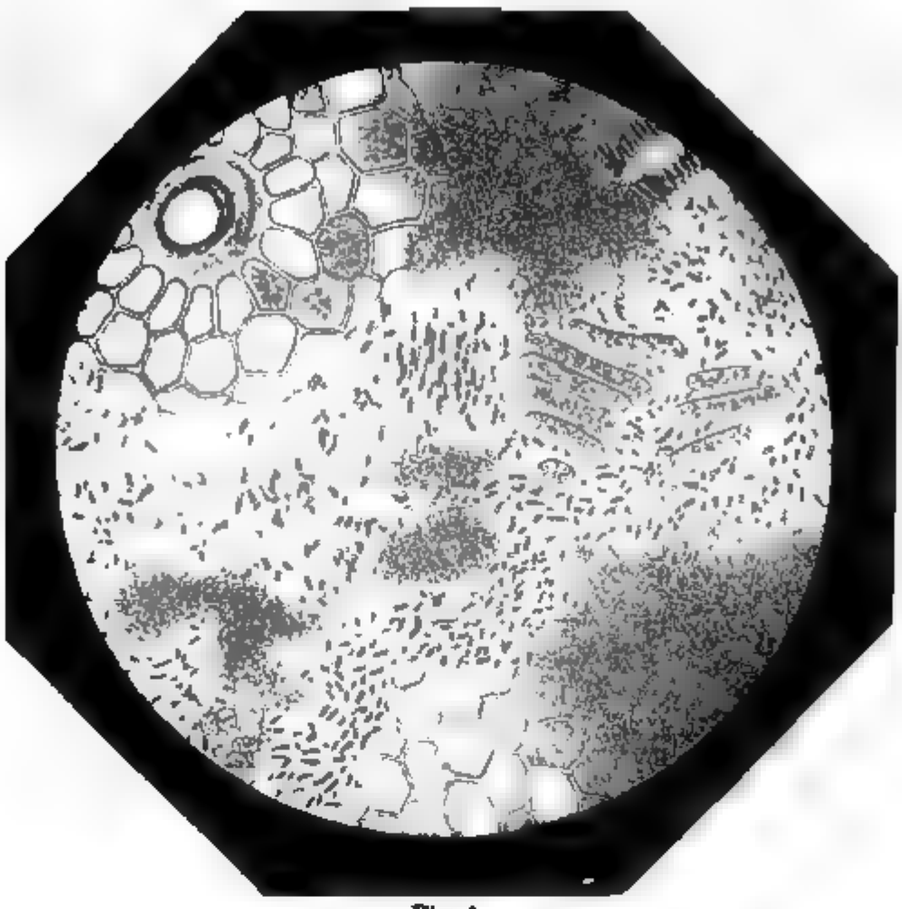


Fig .1.

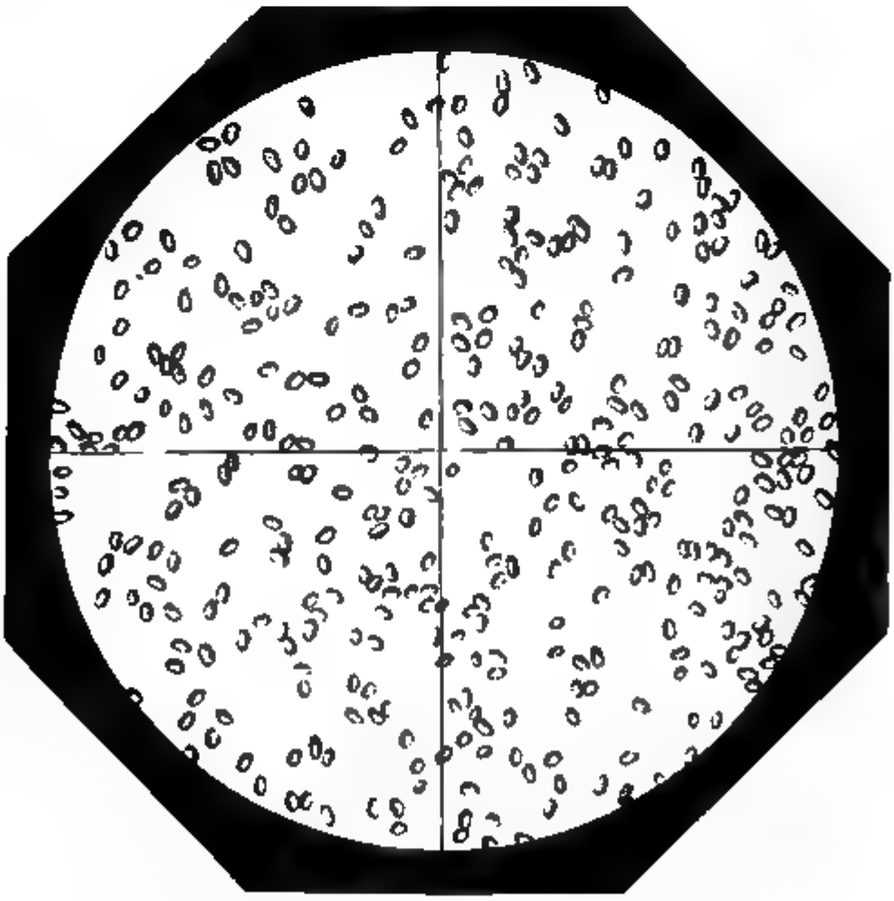
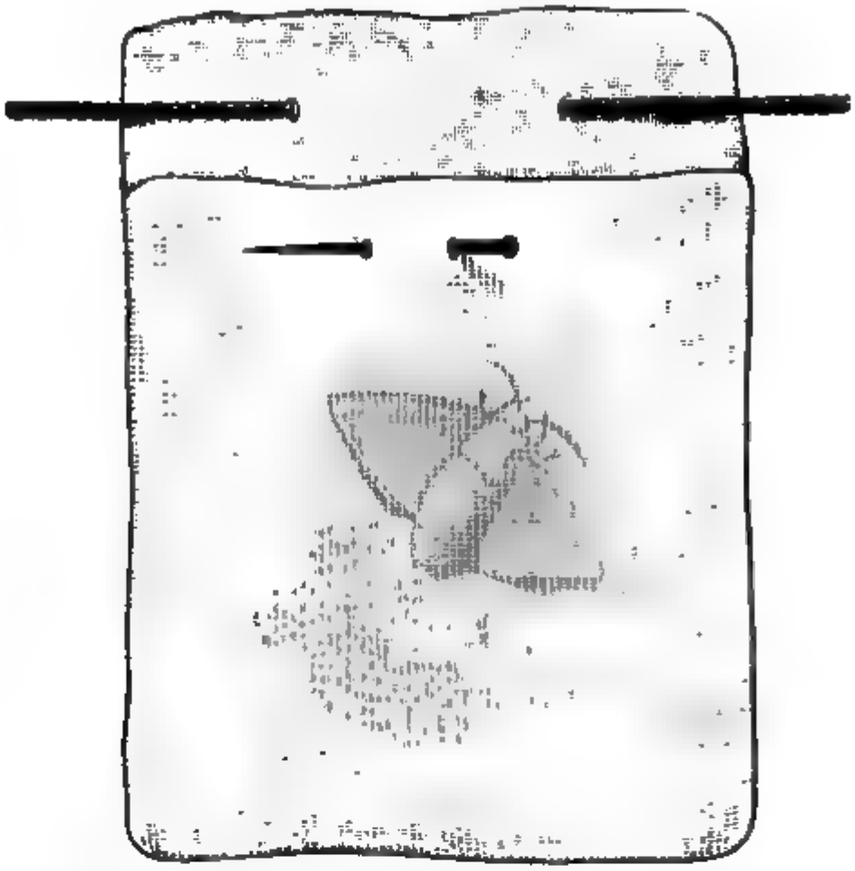


Fig. 2.



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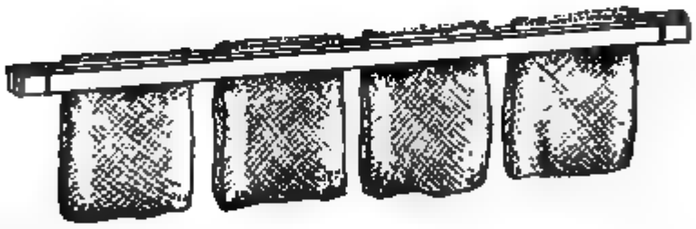


Fig. 2.

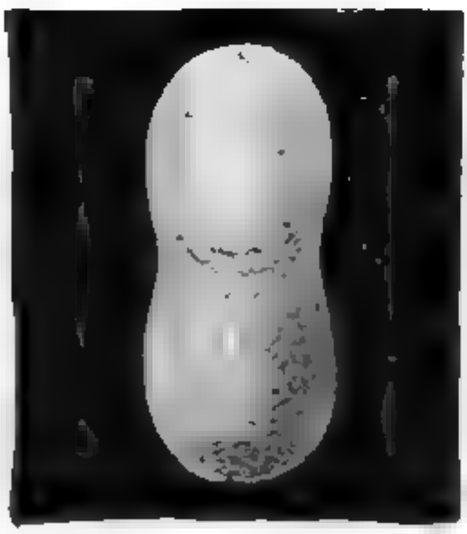


Fig. 3.

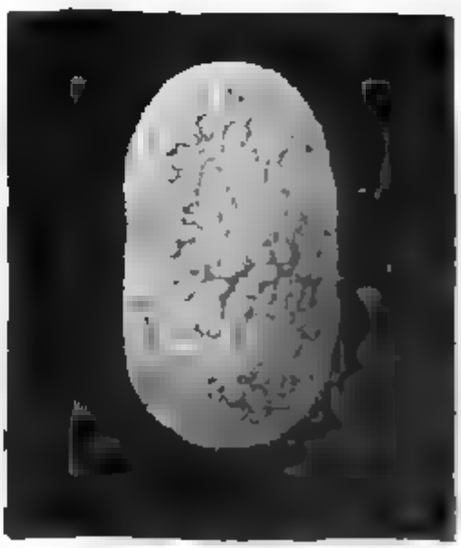


Fig. 4.

SILK CULTURE—EGG PRODUCTION.

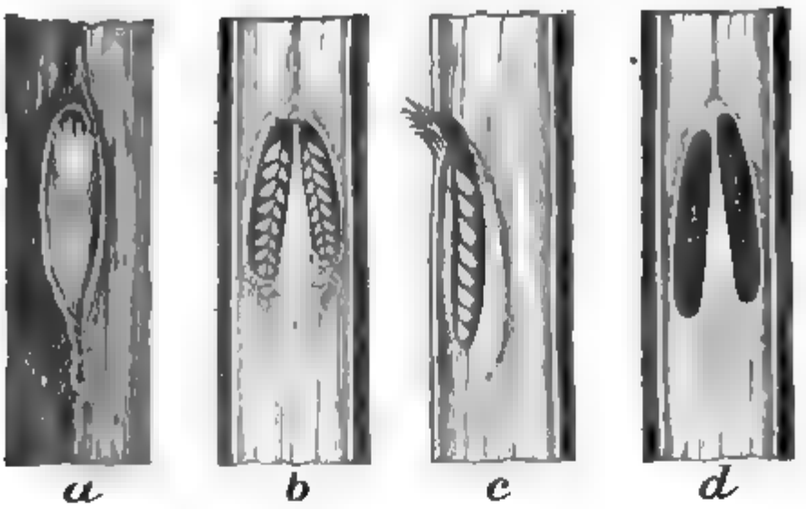


Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

THE PERIODICAL CICADA.

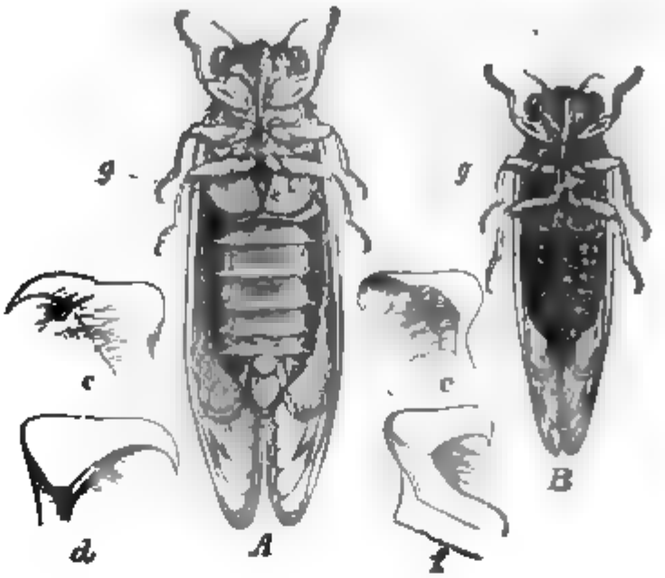


Fig. 1.

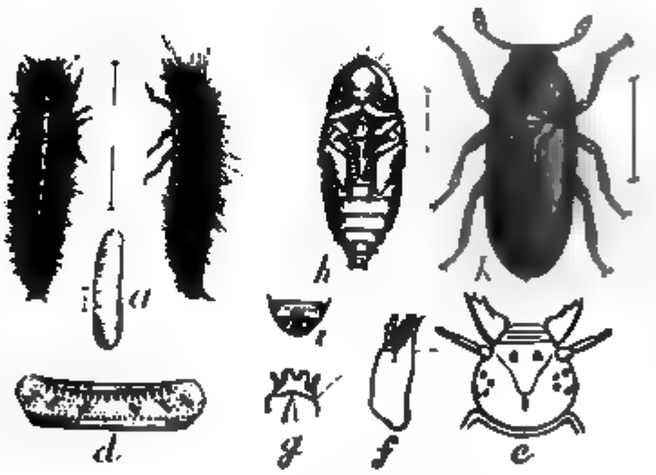


Fig. 2

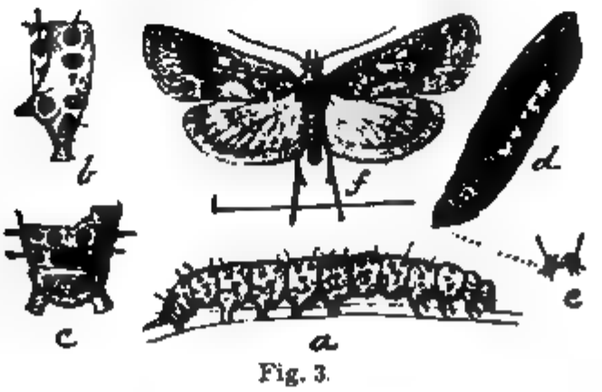


Fig. 3.

Fig. 1.

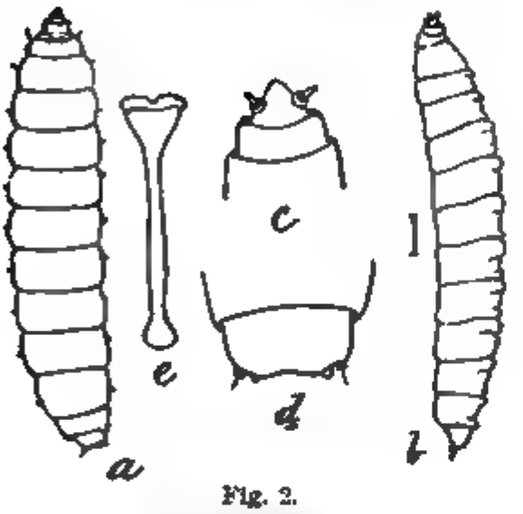


Fig. 2.

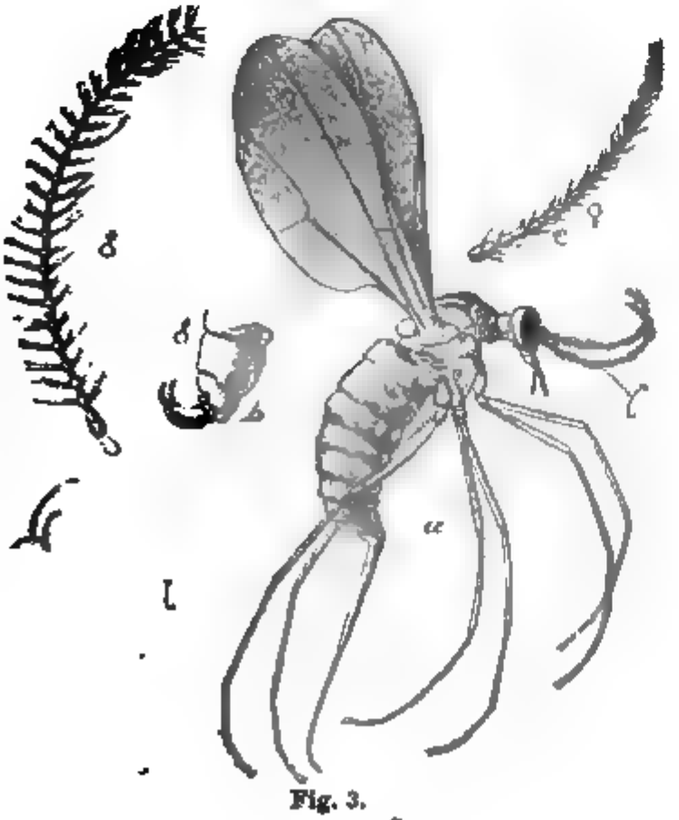


Fig. 3.

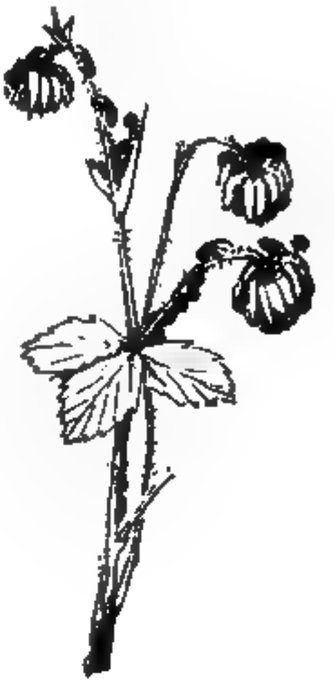


Fig. 5.

Fig. 6.

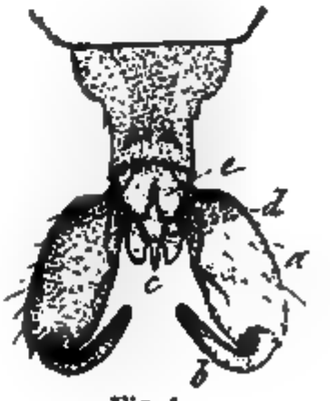


Fig. 4.

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

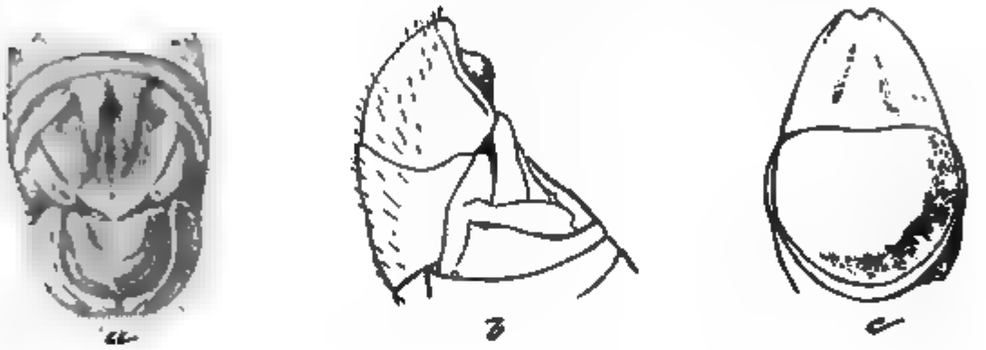


Fig. 5.

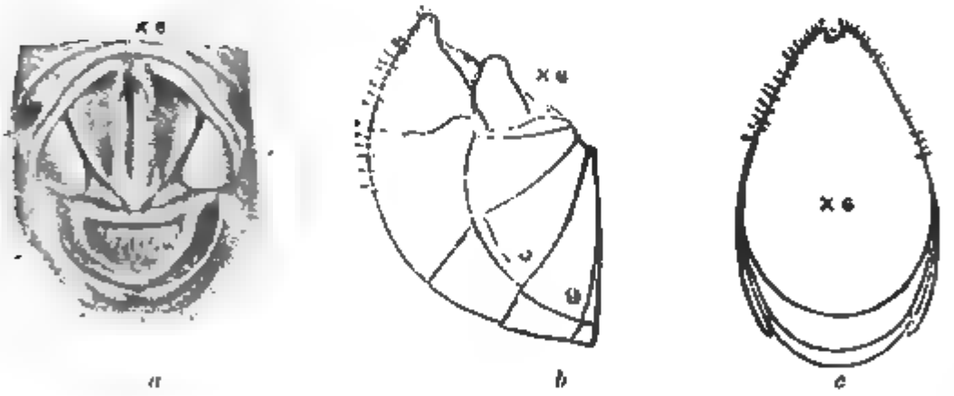


Fig. 6.

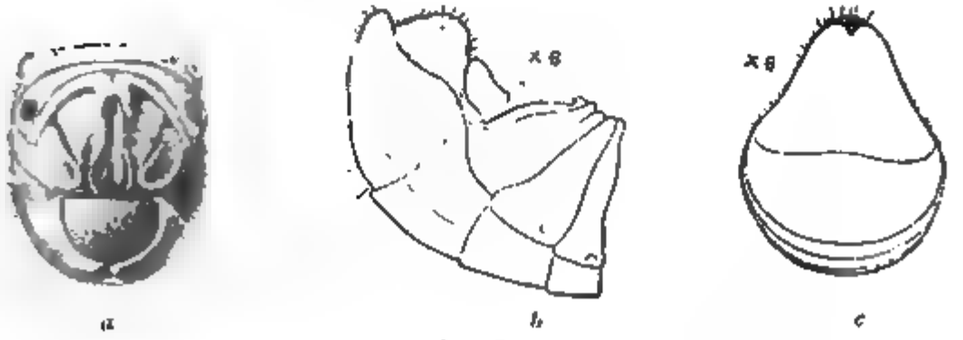


Fig. 7.

g. 1.

Fig. 2.

. 3.

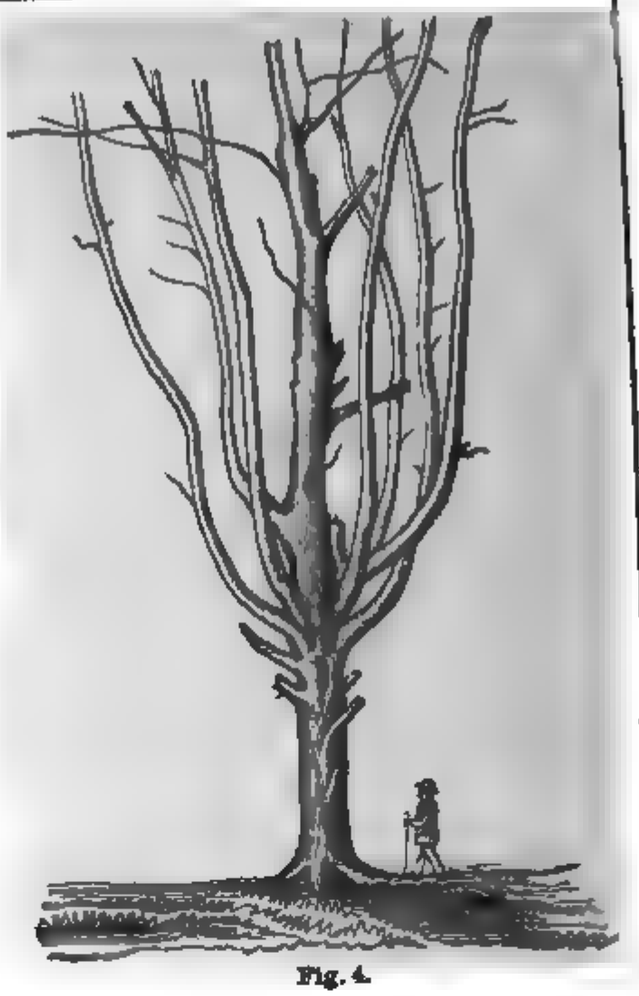


Fig. 4.

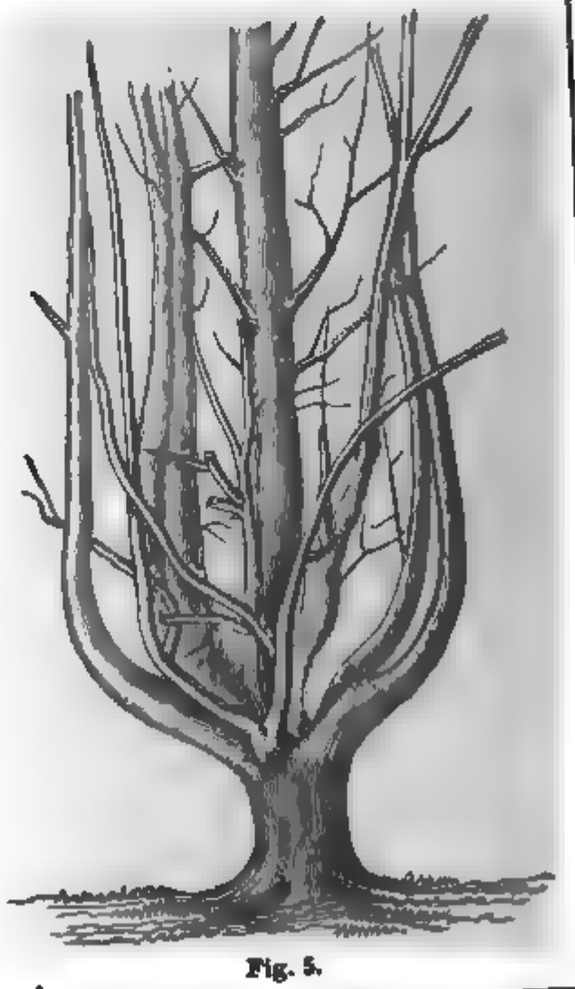


Fig. 5.

THE WHITE-PINE WEEVIL.

)RT OF THE STATISTICIAN.

he honor to submit my seventeenth annual report as eing the twenty-second annual report of the operations of the Department service.

this work is more extensive and more influential, and a guide to the farmer in distribution of crop areas and ig of his products. The organized agencies in the in- ation, the influences adverse to honest trade, are appar- more persistent and reckless each season, rendering icial presentation of the facts of production in a spirit ness, that can neither be moved by fear nor biased by e of private gain.

of the Department are bitterly assailed by speculators, high, by others as too low, while the market can be criticism; yet at the end of the year both bull and bear es as substantially correct, quote them, and base their nture supply, visible and invisible, upon them with con- there are exceptions it is in cases which have been too xtreme to admit of so sudden oblivion of recent manipu- or speculative effect.

vement of 1884–'85 has verified the estimates made eight he close of the cotton year so closely that the original nost identical with the sum of cotton production of the conclusion of the February report, based on the last of the season, favored a probable product of 5,667,000 th the August receipts from the crop of 1885, above of the previous crop, made a very close approximation f the cotton movement, much closer than commercial crop, which were at varience with truth a quarter of a more.

rting work has been prompt and efficient, and the thanks nt and of the country are due to the careful and pains- correspondents, who seek no emoluments of office and public good and the advancement of agriculture. They fter year in the study of local crop distribution, rate of changes in crops and methods, acquiring skill with ex- erfecting their judgment of local conditions, content at they are serving their class and their country, and lar education in statistics.

s has been made during the year in the knowledge of an statistics of agriculture. The foreign work, under the Edmund J. Moffat, the agent in charge, who is also deputy at London, has been progressing satisfactorily, and the , an early knowledge of the production and commercial those products most affected by American competition, rably attained. There are great difficulsies, however, in

this statistical field, from the want of unity in official statistical me of different countries, the imperfection of results, and tardiness of pletion and publication of reports.

In recognition of the great importance of administrative improv in these respects, an organization of the International Statistic stitute was effected, at the jubilee meeting of the London Stati Society last summer, for the development of official and scientifi tistics—

(1) By introducing, as far as possible, uniformity in the methods of compili abstracting statistical returns, and by adopting it in the compilation of sta publications, with a view to a comparison of results obtained in different cou

(2) By inviting the attention of Governments to the various problems cap solution by statistical observations, and by applying for information on those s which have not hitherto been adequately subjected to statistical treatment.

(3) By preparing international publications as a means of bringing into c cation the statisticians of various countries.

(4) By endeavoring, through the medium of publications, and, if practica public instruction and other suitable means, to foster the general appreciation tistical science, and to stimulate the interests of Governments and individual study of social phenomena.

The association is limited to one hundred members, more tha of which have already been elected, among them six representing a istrative statistics in this country. Regular sessions are to b biennially, the first in 1886, at a place and time not yet indicated. advancement of statistical science renders necessary the associat official and professional statisticians, and especially internatio operation. This organization is an important movement, with possibilities of usefulness, and may prove especially valuable in t ministrative work in statistics of the great nations of the world.

The statistical information required by committees or memb Congress, by other Departments, by representatives of foreign G ments, by agricultural and commercial organizations, demands creasing amount of time and labor, and receives attention only li by the possibilities of performance, which are reduced by the dif of obtaining skilled and adequate assistants at the low rate of c sation provided in the appropriation for salaries. The salaries a for expert service in this work are about half the rate paid by prising commercial organizations in this country, and only a fou the compensation allowed for similar services by some foreign G ments.

In the statistical work of this office, theory is ever kept subor to fact, and no hobbies are mounted, personal preferences expos prejudices aired; political leanings are unknown in the domain o cultural statistics; the truth, naked and unadorned, in the inte rural progress and national advancement is sought, whether int parties bear, forbear, or oppose; and the welfare of the farming c ever considered, in the belief that rural prosperity is consisten the general weal, the progress of universal industry, the good o sumer and producer, and the increase of national prosperity.

Acknowledgments are cheerfully made for assistance render Statistician by the clerical force in this branch of the Departmen ice, by State agents, and the thousands of correspondents who f initial local data for ultimate reports.

CORN.

The increase of population, the enlargement of exportation o ducts, the opening of the fresh beef export in 1877, and the

. for beef of higher quality, gave a great impetus to corn produc-
:he decade ending in 1879. It is a striking fact that the increase
the latter half of the decade. The reasons are very obvious.
ɜtion of corn had little to do with it, as it never calls for more
per cent. of the crop, usually not more than 3, even in later
vhile the exportation of sixty years past could be supplied from
ɐent. of the last crop; *and the crop of* 1885 *was far greater than*
egate of corn and corn-meal ever sent across the ocean. The aver-
1870 to 1874 was scarcely 1,000,000,000 bushels and much less
in 1873 and 1874 on account of bad seasons. The product
ɔu by a long stride in the very next year, because the scarcity
ɗe the price high and the demand strong; and it averaged for
er half of the decade about 1,400,000,000 bushels. This was the
ɔf scarcity and high prices in Western Europe. The exportation
ubled, the shipment of pork products increased immensely,
-meat shipment commenced, and in the autumn of 1877 the
ɔef movement to Europe was initiated. Then the yields were
ɜbove the average each year, causing low prices, which in turn
the prices of pork and lard, and that reduction largely in-
the foreign demand. So marked was the effect of this rapid
nent of production on price, that the average annual values of
al crops reported in December were reduced from 64.7 cents in
42 in 1875, 37 in 1876, 35.8 in 1877, and 31.8 in 1878.
rea was, of course, considerably enlarged during the period, and
age for ten years was 43,741,331 acres. But it has been larger
The average of the subsequent five years, 1880 to 1884, is
16 acres, an increase of 50 per cent.
roduction of 1870 to 1879 averaged 1,184,486,954 bushels; of five
ɪce, 1880 to 1884, 1,575,194,108 bushels, an increase of 33 per cent.
ld of the recent period was lower, as a result of the poor crops
and 1883, averaging only 23.9 bushels per acre against 27.1 for
ner period, which was about 1 bushel higher than the usual
for a series of years. The law of compensation comes in here,
ɜverage value per acre has been $10.67 against $11.54 for the
lecade, an average much raised by the high price of 1870 and
ɪen the acreage value was about $15.
ɜverage price for five years was 44.7 cents; for ten preceding
2.6 cents. The average value, which was $504,571,048 for ten
. $704,370,178 for the five years since 1879, an increase of almost
ɪt.
ɔmparison is as follows:

dar years.	Total production.	Total area of crop.	Total value of crop.	Average value per bushel.	Average yield per acre.	Average value of yield per acre.
	Bushels.	*Acres.*		*Cents.*	*Bushels.*	
.....	1,717,434,543	62,317,842	$679,714,499	39.6	27.6	$10 91
.....	1,194,916,000	64,262,025	759,482,170	63.6	18.6	11 82
.....	1,617,025,100	65,659,546	783,867,175	48.4	24.6	11 94
.....	1,551,066,895	68,301,889	658,051,485	42.4	22.7	9 63
.....	1,795,528,000	69,683,780	640,735,560	35.7	25.8	9 19
.....	7,875,970,538	330,225,082	3,521,850,889	.....	.....	.....
.....	1,575,194,108	66,045,016	704,370,178	44.7	23.9	10 67
ge for preceding	1,184,486,954	43,741,331	504,571,048	42.6	27.1	11 54

WHEAT.

During the decade which ended with 1879, the product of wheat nearly doubled, and the annual average of estimates for the period was 312,152,728 bushels. The price was higher in the first five years than in the latter half of the period, and the demand was all the greater in those years of deficient yield in Europe, because the price was lower in accord with the commercial policy of buying in the lowest market.

The average product of the five years of the present decade, from 1880 to 1884, inclusive, has advanced nearly 50 per cent., while the equilibrium of foreign production has been measurably restored by return of a normal rate of yield after a cycle of defective crops; the average is 463,973,318 bushels. This enlargement has not resulted from excessive yields, the average rate being 12.3 bushels instead of 12.4 for the ten years period, but from increased area, which is 50 per cent. over the average for the ten years period.

The average value per bushel in 1881 was the highest since 1872, when the average farm price was $1.24. Since that date the limited requirements of Europe have reduced the average, until last December the value was little more than half that of the crop of 1881. This was due to increased area and a higher rate of production in Europe, and an enlarged exportation of wheat from India.

Low prices of wheat are essential to low cost of the manufactures of England and Holland, on which depends measurably the extent and prevalence of commercial distribution of their manufactured products. Therefore, production in India is stimulated, railroad extension there is promoted, shipments from British colonies are encouraged, and wheat obtained in any part of the world that can sell it at the lowest rates. Cheapness is the condition upon which wheat can be exported from this country in the future, except in seasons when the European harvests have disappointed the expectations of the consumers.

The value of an acre of wheat averaged only $8.38 on an average yield of 13 bushels last year, the lowest return of which there is any record, and a figure lower than the accredited estimates of the cost of production. It may confidently be assumed, therefore, that there is no profit in wheat production at present prices.

But there is a class of farmers who made a profit on wheat in 1884. Those who secured 25 bushels per acre, or 20, obtained a small profit, provided the cost of fertilizers was not too large an element of it.

The following statement compares the results of this half decade with those of the preceding decades:

Calendar years.	Total production.	Total area of crop.	Total value of crop.	Average value per bushel.	Average yield per acre.	Average value of yield per acre.
	Bushels.	*Acres.*		*Cents.*	*Bushels.*	
1880	498,549,868	37,986,717	$474,201,850	95.1	13.1	$12 49
1881	383,280,090	37,709,020	456,880,427	119.3	10.2	12 12
1882	504,185,470	37,067,194	444,002,125	88.2	13.6	11 99
1883	421,086,160	36,455,593	383,649,272	91.0	11.6	10 55
1884	512,765,000	39,475,885	330,862,260	64.5	13.0	8 38
Total	2,319,866,588	188,694,409	2,090,195,934	.....	.....	.....
Annual average	463,973,318	37,738,882	418,039,187	90.1	12.3	11 09
Annual average for preceding ten years	312,152,728	25,187,414	327,407,258	104.9	12.4	13 01

OATS.

The increase in the area of oats, taking the average of five years in mparison with that of ten preceding, is large, being 58 per cent. It an advance proportionally larger than that of any other cereal. The asons are apparent. Heretofore the product ot oats has been little ore than one-fourth as much as of corn; the climate renders necessary l e proportion of oats in the ration of horses, as corn is quite too ting, in summer especially. It is gradually coming into extensive for human food, and oatmeal begins to figure in the exports of grain. s tivation is less costly than that of corn. Another cause may be irly med, and proven if questioned, that of the increased weight ne of the grain due to extensive and continued selection and in- ıction of heavy oats from Norway, Sweden, Poland, and Scotland y the Department of Agriculture. In the South there is an unreported of oats used for winter pasture. It is a practice quite general to re for a time in winter the fields intended for harvesting in spring r ly summer, in the low latitudes.

yield, like that of corn, is lower for the last five years, 26.6 in- of 28.4 bushels, in consequence of comparatively poor harvests in nd 1881. The two periods are thus compared:

Calendar years.	Total production.	Total area of crop.	Total value of crop.	Average value per bushel.	Average yield per acre.	Average value of yield per acre.
	Bushels.	*Acres.*		*Cents.*	*Bushels.*	
.....	417, 885, 380	16, 187, 977	$150, 243, 565	36. 0	25. 8	$9 28
.....	416, 481, 000	16, 831, 600	193, 198, 970	46. 4	24. 7	11 48
.....	488, 2[illegible]0, 610	18, 494, 691	182, 978, 022	37. 5	26. 4	9 64
.....	571, 302, 400	20, 324, 962	187, 040, 264	33. 0	28. 1	9 27
.....	583, 628, 000	21, 300, 917	161, 528, 470	28. 0	27. 4	7 58
Total	2, 477, 547, 390	93, 140, 147	874, 989, 291	.....	.....	.....
nnual average	495, 509, 478	18, 628, 029	174, 997, 858	35. 3	26. 6	9 39
nnual average for preceding ten years.....	314, 441, 178	11, 076, 822	111, 075, 223	35. 3	28. 4	10 03

RYE.

This crop is a small one, scarcely 1 per cent. of the cereals of the nited States, yet it is increasing, having nearly doubled in fifteen . It is used mainly by the German population, for the black bread Fatherland, and to some extent in New England in the produc- of what is known elsewhere as the "Boston brown bread," a mixt- of rye and corn-meal. Its use for spirits is very limited in the anufacture of rye whisky. The increase in production over the pre- ding period of ten years is about 43 per cent., while the increase in regate value is but 35 per cent. The statement follows:

Calendar years.	Total production.	Total area of crop.	Total value of crop.	Average value per bushel.	Average yield per acre.	Average value of yield per acre.
	Bushels.	*Acres.*		*Cents.*	*Bushels.*	
.....	24, 540, 829	1, 767, 619	$18, 564, 560	75. 6	13. 9	$10 50
.....	20, 704, 950	1, 789, 100	19, 327, 415	93. 3	11. 6	10 80
.....	29, 960, 037	2, 227, 889	18, 439, 194	61. 5	13. 4	8 28
.....	28, 058, 583	2, 314, 754	16, 300, 503	58. 0	12. 1	7 04
.....	28, 640, 000	2, 343, 963	14, 857, 040	52. 0	12. 2	6 34
al	131, 904, 399	10, 443, 325	87, 488, 712	.....	.....	.....
verage.....	26, 380, 880	2, 088, 665	17, 497, 742	66. 3	12. 6	8 38
verage for preceding	18, 460, 985	1, 305, 061	12, 945, 136	70. 1	14. 1	9 99

BARLEY.

This crop is grown only in certain districts, mainly on the l coast, in New York, and in some of the Western States. Its pro is about a tenth as large as that of wheat, and its area about one-e eenth. The increase has been nearly as large in proportion as th wheat. Its rate of yield varies less than that of wheat, and ave about 22 bushels, while the average of wheat is nearly 12 bushels. average value per acre during five years has been $13.00, while th wheat has been only $11.08. The comparison of two periods lows:

Calendar years.	Total production.	Total area of crop.	Total value of crop.	Average value per bushel.	Average yield per acre.	A v yi
	Bushels.	*Acres.*		*Cents.*	*Bushels.*	
1880	45,165,346	1,843,329	$30,090,742	66.6	24.5	
1881	41,161,330	1,967,510	33,862,513	82.3	20.9	
1882	48,953,926	2,272,103	30,768,015	62.8	21.5	
1883	50,136,097	2,379,009	29,420,423	58.7	21.1	
1884	61,203,000	2,608,818	29,779,170	48.7	23.5	
Total	246,619,699	11,070,769	153,920,863	.....	.....	
Annual average	49,323,940	2,214,154	30,784,173	62.4	22.3	
Annual average for preceding ten years	33,704,652	1,529,357	24,885,503	73.8	22.0	

This grain is the only cereal imported in any appreciable qua The average annual importation and exportation of the last five compared with the ten preceding, is as follows:

	1871–'80.	
	Bushels.	*I*
Importation	6,243,268	10
Exportation	859,078	
Net imports	5,384,190	9

Adding net imports to production, the average amount for ho sumption in the decade was 39,088,842 bushels, and in the five since, 58,817,218 bushels per annum, an increase of over 50 per ce the quantity consumed. An anomalous feature in this supply is th that the foreign barley is 16.1 per cent. of the whole quantity fo sumption, while in the ten years preceding it was only 13.8 per cent. With all our boasted ability to supply the world with cereals, ou pendence on foreign lands for barley is absolutely increasing. Whi increase in population in eight years cannot be more than 20 per the increase of barley consumed is 50 per cent. As the average per acre for five years has been $13.90 for barley and only $11. wheat (last year $11.42 and $8.38), it would seem that routine cro should give place to suggestions of thrift and a larger area be giv barley-growing.

BUCKWHEAT.

This crop has not been favored by suitable late summer and au weather for the best results since 1880. Frosts were destructiv

in 1881 and 1883. There has been a small increase in area. rage value has been diminished mainly by decline in rate of

ndar years.	Total production.	Total area of crop.	Total value of crop.	Average value per bushel.	Average yield per acre.	Average value of yield per acre.
	Bushels.	*Acres.*		*Cents.*	*Bushels.*	
.....	14, 617, 535	822, 802	$8, 682, 488	59. 4	17. 7	$10 55
.....	9, 486, 200	828, 815	8, 205, 705	86. 5	11. 4	9 90
.....	11, 019, 353	847, 112	8, 038, 862	72. 9	13. 1	9 48
.....	7, 668, 954	857, 349	6, 303, 980	82. 2	8. 9	7 35
.....	11, 116, 000	879, 403	6, 549, 020	59. 0	12. 6	7 45
.....	53, 908, 042	4, 235, 481	37, 780, 055	.....	.....	.....
rage.....	10, 781, 608	847, 096	7, 556, 011	70. 1	12. 7	8 92
rage for preceding ars	9, 747, 272	551, 104	6, 972, 974	71. 5	17. 7	12. 65

AGGREGATE OF CEREALS.

crease in average production, comparing five years with the g decade, is 40 per cent., though the yield of 1881 was but little e average of 1880 and 1879. The rate of yield has been much less, the occurrence of unfavorable seasons, the increase in area per cent. The comparison follows:

Calendar years.	Bushels.	Acres.	Value.
.....	2, 718, 193, 501	120, 926, 286	$1, 861, 497, 704
.....	2, 066, 029, 570	123, 388, 070	1, 470, 957, 200
.....	2, 699, 894, 496	126, 568, 535	1, 466, 609, 393
.....	2, 629, 319, 089	130, 633, 556	1, 280, 765, 927
.....	2, 992, 880, 000	136, 292, 766	1, 184, 811, 520
.....	13, 105, 816, 656	637, 809, 218	6, 766, 225, 744
ive years.....	2, 621, 163, 331	127, 561, 843	1, 353, 245, 149
en preceding years.....	1, 872, 993, 769	83, 391, 088	987, 857, 142

verage annual value is higher by 37 per cent.; while the pro- was 40 per cent. greater, the values per bushel average a little an in the previous years.

verage to each inhabitant for the decade was 42 bushels. Not- ding some reduction in yield the area has been sufficiently in- to make the average for five years, the first half of the present 49 bushels. This is three times the average supply per head uropean production of cereals.

POTATOES.

ses of this crop are unchanged, there is no export demand, requirements of consumption are only affected by increase of . The highest price in ten years was 90.9 cents in 1881, crop was 109,145,494 bushels, against an average of 132,837,175 the period of ten years, and 169,316,799 for the later five.

In this crop the price is controlled entirely by the home supply. Th lowest price was in the year of largest yield per acre, in 1875.

The average value per bushel is 51.9 cents against 56.2 for the pr ceding ten years. The yield per acre has averaged 80.1 bushels, agains 87.7 for the former period. The value per acre is $41.55 against $49.3 The large element of labor in this crop makes the cost of productio high, the profit coming with a heavy rate of yield. The statement as follows:

Calendar years.	Total production.	Total area of crop.	Total value of crop.	Average value per bushel.	Average yield per acre.	Averag value yield p acre.
	Bushels.	*Acres.*		*Cents.*	*Bushels.*	
1880	167,659,570	1,842,510	$81,062,214	48.3	91.0	$44
1881	109,145,494	2,041,670	99,201,341	90.9	53.5	48
1882	170,972,508	2,171,636	95,304,844	55.7	78.7	43
1883	208,164,425	2,269,275	87,849,901	42.2	91.0	38
1884	190,642,000	2,220,980	75,524,290	39.6	85.8	34
Total	846,583,997	10,566,071	439,032,680	.....	.....	.....
Annual average	169,316,799	2,113,214	87,806,536	51.9	80.1	41
Annual average for preceding ten years	132,837,175	1,514,045	74,653,771	56.2	87.7	49

HAY.

The increase in hay production has been 40 per cent. over the averag of the preceding ten years; the enlargement of production has been i the same ratio, as the average yield is 1.23 tons in each period. Th price is lower than in the early years of the preceding decade, and th proportion of wild or prairie hay cut in the distant West is larger, r ducing the average price per ton from $11.36 to $9.66. The statemen is as follows:

Calendar years.	Total production.	Total area of crop.	Total value of crop.	Average value per ton.	Average yield per acre.	Averag value yield p acre.
	Tons.	*Acres.*			*Tons.*	
1880	31,925,235	25,863,955	$371,811,084	$11 65	1.23	$14
1881	35,135,064	30,888,700	415,131,366	11 82	1.14	13
1882	38,138,049	32,339,585	369,958,158	9 70	1.18	11
1883	46,864,009	35,515,948	383,834,451	8 19	1.32	10
1884	48,470,460	38,571,593	396,139,309	8 17	1.26	10
Total	200,532,815	163,179,781	1,936,874,368	.....	.....	.....
Annual average	40,106,563	32,635,956	387,374,874	9 66	1.23	11
Annual average for preceding ten years	28,526,750	23,142,841	323,935,991	11 36	1.23	14

TOBACCO.

This is the only product of agriculture, cotton excepted, that is grow for exportation more than consumption. Like cotton, it is limited i geographical distribution, confined not merely to a group of States, bu to certain districts within those States. The entire area cultivate

uals about 1,100 square miles, or the superficial area of two small unties. The shipping and manufacturing tobacco is nearly all grown the middle belt, in parts of Maryland, Virginia, North Carolina, , Kentucky, and Missouri; while the cigar tobacco, the seed- varieties, are produced entirely in the Northern States, in a few es in the States of Massachusetts, Connecticut, New York, Pennsylvania, Ohio, and Wisconsin.

The average estimated annual production of the ten years from 1870 1879 was 464,920,000 pounds; the crop area, 629,944 acres; the annual value, $39,770,600. For the past five years, 483,401,443 pounds, 34 acres, and a valuation of $42,055,493. The value per pound is us made 8.7 cents (an increase of 1 mill per pound), the yield per acre 34 pounds, and the average value per acre $63.89. All of these re- in remarkable uniformity with those for the preceding period. proportion exported has formerly been nearly three-fifths. The ement of consumption, with increase of population, is rapidly ng this proportion, so that the quantity required in this country ter than the demand from abroad. The foreign demand does ncrease. The average annual exportation for five years has been 34,594 pounds; for ten years preceding 252,945,900 pounds. There herefore been a marked decrease in the exportation, while con- ion has increased. In the previous period more than half was ted; in the last five years the consumption has been considerably than half.

Calendar years.	Total production.	Total area of crop.	Total value of crop.	Average value, per pound.	Average yield, per acre.	Average value of yield per acre.
	Pounds.	*Acres.*		*Cents.*	*Pounds.*	
.....	460,000,000	610,000	$39,100,000	8.5	754.1	$64 10
.....	450,880,014	646,239	43,372,000	9.6	697.7	67 11
.....	513,077,558	671,522	43,189,951	8.4	764.1	64 32
.....	451,545,641	638,739	40,455,362	9.0	706.9	63 34
.....	541,504,000	724,668	44,160,151	8.2	747.2	60 94
Total	2,417,007,213	3,291,168	210,277,464	.....	.....	.....
nual average	483,401,443	658,234	42,055,493	8.7	734.4	63 89
nual average for preceding ten years	464,920,000	629,944	39,770,600	8.6	738.0	63 13

The early returns of tobacco in the days of heavy taxation were far t of the fact. In a special report on tobacco for the census of ou the present Statistician, then in charge of the statistics of agriculture of the census, revised the former estimate to correspond with gures of consumption and distribution, which were obtained very accurately by compilation of the revenue office data of manufacture, and e records of exportation. The requirements of the trade at the present demand the production of very nearly 500,000,000 pounds of leaf annum.

CROP ESTIMATES FOR 1884.

Table showing the product of the cereals, potatoes, tobacco, hay, and cotton, of the States named, the yield per acre, the total acreage, the average price in each State, value of each crop, for 1884.

States.	Products.	Quantity produced in 1884.	Average yield per acre.	Number of acres in each crop.	Value per unit of quantity.
Maine	Indian corn ..bushels.	1,003,000	34.7	30,610	$0 75
	Wheat ..... do .	020 000	15.0	41,965	1 25
	Rye ..... do..	32.000	13.1	2,409	90
	Oats ..... do ..	2,428,000	29.0	83,733	43
	Barley ..... do ..	265.000	21.7	12,180	73
	Buckwheat.....do ..	360,000	17.0	21,185	56
	Potatoes ..... do...	5,812,000	97.0	60,228	48
	Hay .....tons..	1,029,760	.95	1,083,958	12 25
	Total	.....	.....	1,330,208	.....
New Hampshire...	Indian corn ..bushels..	1,286,000	33.2	38,774	76
	Wheat .....do ..	171,000	14.7	11,615	1 20
	Rye .....do...	30,000	9.1	3,313	80
	Oats.....do....	003,000	32.5	30,588	45
	Barley .....do....	76,000	20.2	3,748	70
	Buckwheat.....do	77,000	16.3	4,690	60
	Potatoes ..... do ...	2,588,000	95.0	27,034	40
	Tobacco .... pounds..	136,000	1,417.0	96	11.8
	Hay .. .. tons..	585,058	.95	615,851	13 00
	Total	.....	.....	735,708	.....
Vermont.....	Indian corn ..bushels..	1,990,000	33.2	60,282	65
	Wheat ..... do....	368,000	18.7	21,789	1 05
	Rye ....do....	86,000	13.8	6,354	71
	Oats ..... do ..	3,625,000	35.0	103,530	40
	Barley ..... do...	265,000	23.1	11,481	67
	Buckwheat .....do ...	301,000	16.9	17,862	65
	Potatoes ..... do ..	3,482,000	98.0	35,528	38
	Hay .....tons..	955,238	1.0	955,238	13 00
	Total	.....	.....	1,212,064	.....
Massachusetts	Indian corn..bushels..	1,941,000	34.0	57,097	72
	Wheat ..... do.....	19,000	17.8	1,070	1 12
	Rye..... do ..	393,000	15.5	25,306	81
	Oats .....do....	717,000	30.4	23,500	45
	Barley ..... do...	75,000	27.2	2,248	83
	Buckwheat.....do ..	87,000	16.2	5,368	80
	Potatoes ... ... do ...	3,154,000	93.0	33,916	65
	Tobacco .... pounds	3,715,000	1,361.0	2,730	12.2
	Hay..... .....tons.	550,133	.90	611,259	17 50
	Total	.....	.....	763,574	.....
Rhode Island.....	Indian corn..bushels..	390,000	30.4	12,810	78
	Rye .....do ...	16,000	11.3	1,886	75
	Oats.....do....	161.000	27.4	5,852	47
	Barley .....do....	20,000	24.8	824	80
	Buckwheat.....do ..	1,000	10.0	126	80
	Potatoes ..... do...	643,000	90.0	6,496	70
	Hay ..... tons....	69,657	1.0	69,657	17 30
	Total	.....	.....	97,180	.....
Connecticut	Indian corn bushels	1,769,000	31.0	57,000	65
	Wheat ..... do ..	36,000	16.5	2,193	1 60
	Rye .... do ..	353.000	12.0	29,393	72
	Oats .....do ..	1,112,000	29.6	37,512	42
	Barley ..... do ..	14,000	22.2	632	75
	Buckwheat... ..do ...	134.000	12.1	11,067	70
	Potatoes ... . do .	3,555,000	81.0	31,544	60
	Tobacco .....pounds	9,481,000	1,176.0	8,064	12.4
	Hay ..... tons	459,766	.80	574,707	17 00
	.....	.....	.....	782,122	.....

showing the product of the cereals, potatoes, hay, and cotton, &c.—Continued.

tes.	Products.	Quantity produced in 1884.	Average yield per acre.	Number of acres in each crop.	Value per unit of quantity.	Total valuation.
rk	Indian corn..bushels	22, 674, 000	30.1	753, 619	$0 60	$13, 604, 400
	Wheat .....do ..	12, 729, 000	16.5	772, 323	85	10, 819, 650
	Rye ..... do ..	2, 660, 000	11.1	239, 268	68	1, 609, 500
	Oats ..... do ..	41, 145, 000	30.0	1, 371, 530	35	14, 400, 750
	Barley..... .. do ..	7, 957, 000	22.5	354, 086	66	5, 251, 620
	Buckwheat.....do...	4, 249, 000	13.8	308, 350	56	2, 379, 440
	Potatoes .. . .. do .	83, 904, 000	94.0	360, 682	39	13, 222, 560
	Tobacco.....pounds..	8, 162, 000	1, 515.0	5, 386	12	979, 440
	Hay .....tons..	5, 458, 874	1.10	4, 962, 158	12 50	68, 229, 675
	Total	....	... .	9, 127 592	.. . ..	130, 557, 035
ney.....	Indian corn. bushels	10, 992, 000	32.0	343, 600	64	6, 935, 680
	Wheat..... do...	2, 022, 000	13.0	155, 540	90	1, 819, 800
	Rye ..... do. ..	1, 024, 000	9.9	103, 516	67	686, 080
	Oats..... do....	2, 735, 000	21.1	129, 564	37	1, 011, 950
	Barley..... do ..	4, 000	18.7	254	68	2, 720
	Buckwheat.....do ..	445, 000	12.7	35, 026	65	289, 250
	Potatoes.....do....	3, 450, 000	86.0	40, 114	56	1, 897, 500
	Hay ..... tons..	616, 920	1.20	514, 100	14 75	9, 099, 570
	Total	....	.....	1 321, 616	.....	20, 742, 550
rginia.....	Indian corn . bushels .	43, 466, 000	31.0	1, 403, 000	53	22, 602, 320
	Wheat..... do....	20, 820, 000	13.6	1, 533, 640	86	17, 905, 200
	Rye ..... do....	4, 090, 000	10.1	406, 241	64	2, 617, 600
	Oats.....do...	35, 027, 000	27.9	1, 253, 968	35	12, 259, 450
	Barley.....do....	573 000	21.4	26, 729	66	378, 180
	Buckwheat..... do....	3, 207, 000	12.4	258, 910	58	1, 860, 060
	Potatoes... . .. do...	16, 837, 000	85.0	192, 202	39	6, 371, 430
	Tobacco.....pounds .	34, 143. 000	1, 314. 0	25, 991	10. 5	3, 585, 615
	Hay ..... tons	3, 253, 745	1. 20	2, 711, 467	12 00	39, 044, 976
	Total	....	.....	7, 812, 068	.....	106, 624, 231
a.....	Indian corn .bushels .	3, 975, 000	18.5	214, 450	43	1, 709, 250
	Wheat ..... do .	1, 007, 000	10. 6	94, 700	85	855, 950
	Rye.....do ...	7, 000	7. 9	887	65	4, 550
	Oats .. ..do....	462, 000	23. 4	20, 580	35	163, 700
	Buckwheat..... do ..	7, 000	16. 4	427	55	3, 850
	Potatoes ..... do ...	235, 000	57 0	4, 141	58	132, 160
	Hay .....tons..	48, 655	1. 0	48, 655	14 00	681, 170
	Total	....	.....	389, 910	.....	3, 555, 630
a.....	Indian corn . bushels..	15, 237, 000	21. 8	698, 400	48	7, 313, 760
	Wheat ..... do ..	8, 260, 000	12. 8	644, 080	83	6, 855, 800
	Rye ..... do ...	321, 000	11. 0	29, 294	65	208, 650
	Oats ....do ..	1, 980, 000	18. 0	110, 000	35	693, 000
	Barley..... do ...	7, 000	26. 1	252	70	4, 900
	Buckwheat.....do....	185, 000	12. 7	10, 079	70	94, 500
	Potatoes ..... .do....	1, 412, 000	70. 0	20, 176	50	706, 000
	Tobacco .....pounds..	31, 255, 000	748. 0	41, 811	7. 5	3, 281, 615
	Hay .....tons.	311, 872	1. 10	283, 520	13 95	4, 088, 742
	Total	... .	.....	1, 839, 112	.....	22, 196, 967
.....	Indian corn . bushels .	29, 480, 000	15. 2	1, 938, 391	56	16, 508, 800
	Wheat ..... do ..	7, 455. 000	8. 0	930, 200	90	5, 924, 000
	Rye .....do ...	326, 000	6. 8	51, 846	67	219, 760
	Oats.....do ...	6, 418, 000	10. 8	621, 250	43	2, 695, 560
	Barley ..... do ...	17, 000	14. 4	1, 182	70	11, 900
	Buckwheat ..... do ..	205, 000	12. 8	16, 587	70	143, 500
	Potatoes do ..	2, 081, 000	60. 0	34, 350	55	1, 133, 550
	Tobacco .....pounds	99, 763, 000	667. 0	149, 495	7. 4	7, 382, 462
	Hay ... ... tons	360, 380	1 30	281, 836	12 00	4, 296, 668
	Cotton .. ..bales	13 500	. 29	46, 302	*9. 3	593, 852
	Total	....		4, 071, 401	.....	39, 050, 052
rolina...	Indian corn. bushels .	31, 499, 000	12. 5	2, 519 927	60	18, 890, 460
	Wheat ..... do	4, 850, 000	5. 1	767, 290	80	4, 138, 500
	Rye..... do ..	367, 000	5. 6	65, 551	80	293, 600
	Oats.....do ...	4, 622, 000	7. 5	617, 646	46	2, 126, 120
	Barley ..... do ...	3, 000	10. 2	268	95	2, 850
	Buckwheat .....do ...	48, 000	8. 7	5, 596	70	34, 300
	Potatoes .. . do ..	1, 260, 000	63. 0	19, 997	55	693, 000
	Tobacco .....pounds.	34, 858, 000	501. 0	69, 600	11. 5	4, 008, 670
	Hay ..... tons.	105, 838	1. 20	81, 414	10 60	1, 121, 883
	Cotton.....bales	404, 100	. 38	1, 061, 048	*9. 3	17, 663, 211
	Total	....	.....	5, 206, 397	.....	48, 981, 534

*Per pound.

Table showing the product of the cereals, potatoes, hay, and cotton, &c.—Continu

States.	Products.	Quantity produced in 1884.	Average yield per acre.	Number of acres in each crop.	Value per unit of quantity.	T val
South Carolina.....	Indian corn . bushels .	13, 320, 000	9.2	1, 444, 020	968	9
	Wheat ..... do	1, 410, 300	6.1	231, 610	1 05	1
	Rye ..... do ..	32, 000	3.8	8, 285	1 00	
	Oats ..... do ...	3, 545, 000	9.0	394, 250	50	1
	Barley. ..... do ...	18, 000	15.2	1, 212	1 00	
	Potatoes..... do....	224, 000	60.0	3, 725	80	
	Hay ..... tons	3, 738	1.30	2, 990	12 70	
	Cotton.....bales..	511, 800	.30	1, 716, 128	*9.3	22
	Total	.....	.. ..	3, 802, 220	... .	
Georgia.....	Indian corn ..bushels..	30, 925, 000	10.8	2, 857, 700	70	21
	Wheat ..... do .	3, 130, 000	6.4	487, 500	1 05	3
	Rye ..... do ..	145, 000	5.4	27, 085	1 20	
	Oats..... do ...	6, 270, 000	8.9	702, 614	57	3
	Barley.....do ..	22, 000	13.0	1, 695	1 05	
	Potatoes..... do ...	615, 000	67.0	9, 175	1 04	
	Hay .....tons..	19, 668	1.30	15, 129	13 30	
	Cotton.....bales..	807, 400	.27	2, 958, 930	*9.3	
	Total	....	... .	7, 059, 799	.....	6
Florida.....	Indian corn..bushels..	3, 687, 000	9.5	403, 913	80	2
	Oats .....do....	494, 000	9.4	52, 560	60	
	Potatoes .....do...	180, 000	90.0	1, 998	1 10	
	Hay ..... tons..	274	1.30	211	19 00	
	Cotton.....bales..	57, 300	.21	268, 111	*9.1	2
	Total	.....	.....	726, 793	.. ..	4
Alabama	Indian corn..bushels .	30, 197, 000	13.0	2, 322, 885	61	18
	Wheat ..... do .	1, 675, 000	6.0	278, 450	1 00	1
	Rye .. .. do ..	33, 000	5.4	6, 059	1 25	
	Oats .....do ...	5, 015, 000	12.4	405, 830	55	2
	Barley ..... do....	7, 000	10.6	649	1 10	
	Potatoes .....do ...	636, 000	70.0	9, 081	1 00	
	Hay ..... tons..	13, 058	1.20	10, 882	13 40	
	Cotton .....bales..	648, 700	.24	2, 740, 941	*9.3	
	Total	.....	.....	5, 774, 777	.....	5
Mississippi	Indian corn..bushels.	25, 510, 000	13.5	1, 889, 600	62	15
	Wheat .....do....	288, 000	4.9	48, 000	1 00	
	Rye .....do....	5, 000	6.4	840	1 20	
	Oats .....do....	3, 048, 000	8.9	343, 040	57	
	Potatoes .....do .	598, 000	72.0	8, 305	87	
	Hay ..... tons..	12, 513	1.30	9, 625	12 35	
	Cotton.....bales.	883, 200	.37	2, 802, 447	*9.3	
	Total	.....	.....	4, 696, 917	.....	5
Louisiana.....	Indian corn..bushels..	11, 007, 000	12.7	865, 450	67	
	Rye ..... do ..	8, 000	6.0	1, 260	1 20	
	Oats ..... do ...	404, 000	11.5	35, 119	58	
	Potatoes .....do ..	472, 000	79.0	6, 055	84	
	Hay ..... tons.	47, 810	1.30	36, 777	11 00	
	Cotton.....bales..	485, 200	.53	922, 581	*9.3	2
	Total	.....	.....	1, 867, 242	.....	2
Texas.....	Indian corn. bushels..	60, 290, 000	16.1	3, 752, 700	62	3
	Wheat ..... do ..	5, 561, 000	10.0	556, 600	67	
	Rye .....do ...	50, 000	10.6	5, 544	68	
	Oats ..... do ...	10, 527, 000	32.0	478, 510	42	
	Barley .....do ..	124 000	15.9	7, 836	70	
	Potatoes ..... do ..	560, 000	65.0	8, 708	95	
	Hay . ..... tons	84, 782	1 20	70, 652	10 25	
	Cotton .....bales..	995, 400	.31	3, 196, 668	*9.0	4
	Total	....	....	8, 007, 218	.....	
Arkansas.....	Indian corn .bushels .	32, 465, 000	18.5	1, 757, 710	54	1
	Wheat .... do . .	1, 885, 000	7 6	248, 450	93	
	Rye ..... do....	28, 000	6.8	4, 198	1 05	
	Oats ..... do ..	3, 542, 000	15.5	228, 440	45	
	Potatoes ..... do .	876, 000	72.0	12, 147	65	
	Tobacco..... pounds..	1, 111, 000	508.0	2, 185	7.5	
	Hay ..... tons.	32, 176	1.30	24, 751	13 75	
	Cotton... .....bales..	581, 400	.42	1, 250, 368	*9.3	
	Total	.....	.....	3, 537, 789	.....	4

*Per pound.

showing the product of the cereals, potatoes, hay, and cotton, &c.—Continued.

States.	Products.	Quantity produced in 1884.	Average yield per acre.	Number of acres in each crop.	Value per unit of quantity.	Total valuation.
ssee.....	Indian corn. bushels..	65, 723, 000	20. 3	3, 245, 082	$45	$29, 575, 350
	Wheat ..... do ..	9, 320, 000	7. 0	1, 336, 230	75	6, 990, 000
	Rye ..... do ..	209, 000	5. 8	36, 137	70	146, 300
	Oats ..... do ..	7, 680, 000	13. 5	568, 895	42	3, 225, 600
	Barley .... do....	16, 000	15. 1	3, 091	72	33, 120
	Buckwheat.....do....	33, 000	6. 2	5, 303	68	22, 440
	Potatoes ..... do ..	2, 390, 000	62. 0	38, 551	50	1, 195, 000
	Tobacco.....pounds..	31, 392, 000	697. 0	45, 048	7	2, 197, 440
	Hay ..... tons.	217, 316	1. 20	181, 097	12 00	2, 607, 792
	Cotton.....bales.	313, 800	.38	815, 678	*9. 2	14, 153, 949
	Total	.....	... .	6, 275, 102	.....	60, 146, 991
Virginia.....	Indian corn .bushels..	11, 900, 000	20. 0	594, 115	56	6, 664, 000
	Wheat ..... do ...	3, 318, 000	10. 5	316, 425	80	2, 654, 400
	Rye .....do....	153, 000	8. 4	18, 108	75	114, 750
	Oats.....do....	2, 212, 000	17. 0	130, 235	39	862, 680
	Barley ..... do....	11, 000	19. 7	567	75	8, 250
	Buckwheat..... do ..	283, 000	8. 6	32, 776	72	203, 760
	Potatoes ..... . do .	1, 893, 000	72. 0	26, 294	52	984, 360
	Tobacco.....pounds	2, 843, 000	565. 0	4, 149	9. 6	224, 038
	Hay .....tons..	250, 846	1. 10	228, 042	10 00	2, 508, 460
	Total	.....	.....	1, 350, 690	.....	14, 225, 588
ky	Indian corn .bushels..	71, 880, 000	22. 1	3, 258, 410	43	30, 908, 400
	Wheat .....do....	13, 425, 000	10. 8	1, 272, 000	74	9, 934, 500
	Rye. .....do....	846, 000	8. 8	96, 234	60	507, 600
	Oats.....do ..	7, 865, 000	18. 4	427, 430	35	2, 752, 750
	Barley ....do....	459, 000	22. 3	20, 594	60	275, 400
	Buckwheat.....do ...	12, 000	10. 2	1, 225	70	8, 400
	Potatoes ..... do....	3, 728, 000	73. 0	51, 067	40	1, 491, 200
	Tobacco.....pounds.	208, 692, 000	756. 0	276, 139	7. 5	15, 651, 900
	Hay .....tons..	351, 000	1. 30	270, 000	9 75	3, 422, 250
	Total	.....	.....	5, 673, 099	.....	64, 950, 400
.....	Indian corn ..bushels..	85, 393, 000	30. 0	2, 846, 684	41	35, 011, 130
	Wheat .....do....	41, 186, 000	15. 3	2, 691, 986	75	30, 889, 500
	Rye .....do....	327, 000	8. 9	36, 869	56	183, 120
	Oats .....do....	23, 419, 000	28. 0	836, 400	29	6, 791, 510
	Barley .....do ...	955, 000	26. 7	36, 394	61	600, 850
	Buckwheat.....do....	98, 000	8. 5	11, 500	70	68, 600
	Potatoes .....do ...	12, 090, 000	75. 0	161, 199	43	5, 077, 800
	Tobacco.....pounds..	29, 349, 000	816. 0	35, 983	7. 2	2, 113, 128
	Hay .....tons..	3, 185, 000	1. 30	2, 450, 000	10 00	31, 850, 000
	Total	.....	.....	9, 107, 445	.....	112, 585, 638
an.....	Indian corn ..bushels .	26, 022, 000	28. 0	929, 388	40	10, 408, 800
	Wheat ..... do ..	29, 772, 000	16. 5	1, 804, 365	74	22, 031, 280
	Rye ..... do....	233, 000	10. 2	22, 802	57	132, 810
	Oats.....do...	19, 990, 000	33. 4	597, 864	29	5, 797, 100
	Barley .... do....	1, 101, 000	21. 6	50, 857	57	627, 570
	Buckwheat.....do	441, 000	13. 2	33, 491	60	264, 600
	Potatoes .....do ..	13, 192, 000	90. 0	146, 582	25	3, 298, 000
	Hay.....tons..	1, 741, 027	1. 40	1, 243, 591	9 75	16, 975, 013
	Total	.....	.....	4, 828, 940	.....	59, 535, 173
a.....	Indian corn ..bushels	104, 757, 000	29. 0	3, 612, 312	34	35, 617, 380
	Wheat ..... do....	33, 745, 000	12. 5	2, 708, 016	67	22, 609, 150
	Rye ..... do ..	256, 000	10. 0	25, 511	54	138, 240
	Oats.....do....	21, 742, 000	30. 0	724, 736	27	5, 870, 340
	Barley ..... do ...	443, 000	21. 6	20, 530	57	252, 510
	Buckwheat .. . do ..	80, 000	9. 3	8, 566	67	53, 600
	Potatoes .. .. do....	7, 015, 000	76. 0	92, 305	35	2, 455, 250
	Tobacco.....pounds..	9, 318, 000	727. 0	12, 812	6. 7	624, 306
	Hay .....tons .	2, 016, 000	1. 40	1, 440, 000	7 30	14, 710, 800
	Total	.....	.....	8, 644, 788	....	82, 337, 576

*Per pound.

Table showing the product of the cereals, potatoes, hay, and cotton, &c.—Continue

States.	Products.	Quantity produced in 1894.	Average yield per acre.	Number of acres in each crop.	Value per unit of quantity.	T val
Illinois	Indian corn bushels	244,544,000	30.0	8,151,467	30 31	075
	Wheat do	32,974,000	11 6	2,790,000	03	20
	Rye do	4,896,000	16.2	302,129	47	2
	Oats do	98,153,000	32.8	2,990,983	23	22
	Barley do	982,000	23.5	41,779	51	
	Buckwheat do	548,000	9.7	15,338	67	
	Potatoes do	10,009,000	79.0	125,427	34	3
	Tobacco pounds	3,944,000	988.0	5,730	7	
	Hay tons	4,025,000	1.40	2,875,000	6 24	25
	Total			17,308,755		
Wisconsin	Indian corn bushels	26,200,000	24.6	1,065,365	34	
	Wheat do	20,083,000	14.0	1,434,510	60	1
	Rye do	2,468,000	14.2	174,448	45	
	Oats do	45,040,000	32.5	1,371,334	24	1
	Barley do	7,290,000	23.2	314,610	47	
	Buckwheat do	822,000	8.9	30,033	51	
	Potatoes do	9,849,000	90.0	108,995	26	
	Tobacco pounds	14,406,000	970.0	14,853	10.2	1
	Hay tons	2,122,044	1.30	1,632,034	6 20	1
	Total			6,154,271		8
Minnesota	Indian corn bushels	23,630,000	33.5	705,340	33	
	Wheat do	41,307,000	15.0	2,753,816	50	2
	Rye do	476,000	14.8	32,060	39	
	Oats do	36,100,000	35.2	1,025,136	30	
	Barley do	8,057,000	24.2	334,183	35	
	Buckwheat do	68,000	10.8	6,349	55	
	Potatoes do	5,570,000	91.0	61,319	27	
	Hay tons	3,780,000	1.40	1,960,000	4 48	1
	Total			6,668,203		5
Iowa	Indian corn bushels	252,000,000	34.5	7,329,652	23	5
	Wheat do	31,270,000	12.0	2,605,771	57	1
	Rye do	1,434,000	11.6	123,747	38	
	Oats do	78,650,000	36.7	2,145,959	20	1
	Barley do	4,951,000	22.3	221,999	35	
	Buckwheat do	210,000	10.4	20,077	57	
	Potatoes do	12,618,000	91.0	137,563	28	
	Hay tons	5,062,500	1.40	3,750,000	4 20	2
	Total			10,334,768		11
Missouri	Indian corn bushels	197,850,000	33.0	5,995,931	26	5
	Wheat do	27,500,000	11.8	2,334,705	62	1
	Rye do	588,000	11.7	50,254	50	
	Oats do	30,774,000	26.7	1,152,590	25	
	Barley do	178,000	21.6	8,242	60	
	Buckwheat do	70,000	11.7	6,014	60	
	Potatoes do	6,653,000	85.0	78,275	33	
	Tobacco pounds	15,810,000	978.0	16,170	7 6	
	Hay tons	1,625,000	1.30	1,250,000	6 50	1
	Total			10,892,042		9
Kansas	Indian corn bushels	168,300,000	36.9	4,565,000	22	3
	Wheat do	34,990,000	16.5	2,120,300	45	1
	Rye do	5,042,000	17.2	293,515	35	
	Oats do	27,410,000	35.0	783,413	22	
	Barley do	550,000	25.7	21,613	33	
	Buckwheat do	21,000	11.7	1,709	63	
	Potatoes do	7,402,000	87 0	85,085	45	
	Hay tons	4,940,000	1.30	3,800,000	4 22	
	Total			11,670,625		8
Nebraska	Indian corn bushels	122,100,000	37.7	3,235,298	18	2
	Wheat do	28,325,000	14.5	1,950,280	42	1
	Rye do	1,008,000	16.3	67,385	32	
	Oats do	21,844,000	33.7	648,198	19	
	Barley do	3,551,000	21.0	168,714	33	
	Buckwheat do	24,000	11.2	2,130	55	
	Potatoes do	4,309,000	91 0	47,350	29	
	Hay tons	2,567,500	1.30	1,975,000	3 48	
	Total			8,094,350		4

's showing the product of the cereals, potatoes, hay, and cotton, &c.—Continued.

...s.	Products.	Quantity produced in 1824.	Average yield per acre.	Number of acres in each crop.	Value per unit of quantity.	Total valuation.
.....	Indian corn bushels	4,800,000	30.0	160,000	$0 60	$2,880,000
	Wheat..... do	44,320,000	13.2	3,360,000	72	31,910,400
	Rye ..... do	314,000	10.3	30,409	68	213,520
	Oats ..... do	2,149,000	27.0	79,600	38	816,020
	Barley ..... do	10,217,000	28.0	668,045	52	5,432,840
	Buckwheat .....do	28,000	23.3	1,219	60	16,800
	Potatoes..... do	5,578,000	95.0	58,694	60	3,342,800
	Hay ..... tons	1,395,000	1.50	930,000	10 31	14,382,450
	Total	.....	.....	5,307,940	.....	61,990,430
.....	Indian corn bushels	164,000	27 8	5,890	62	101,680
	Wheat ..... do...	15,462,000	18.0	858,924	48	7,421,760
	Rye .....do	92,000	16.6	1,338	65	14,300
	Oats .....do....	5,470,000	28.0	195,350	30	1,641,000
	Barley. .....do ...	1,239,000	35.9	34,500	47	582,330
	Buckwheat .... do ...	9,600	16.8	561	60	5,400
	Potatoes .. .... do ..	1,385,000	110.0	12,587	30	415,500
	Hay . tons.	526,000	1 50	350,000	10 00	5,250,000
	Total.	.....	.....	1,459,150	.....	15,421,970
.....	Indian corn..bushels..	21,000	28.2	800	68	14,280
	Wheat .....do ...	104,000	18.9	5,515	1 00	104,000
	Oats .....do ...	261,000	31.9	7,958	58	145,580
	Barley .....do ...	686,000	28.1	24,497	80	550,400
	Potatoes .....do....	371,000	80.0	4,640	70	259,700
	Hay.....tons..	190,000	1.30	150,000	8 30	1,618,500
	Total	.....	.....	193,340	.....	2,692,460
.....	Indian corn .bushels .	710,000	28.1	25,300	[redacted]	461,500
	Wheat ..... . do ..	2,848,000	20.0	117,420	[redacted]	1,814,000
	Rye .....do ..	33,000	17.6	1,873	60	19,800
	Oats .....do....	1,616,000	38.0	43,313	40	606,400
	Barley .....do....	158,000	28.0	6,307	57	107,100
	Potatoes.....do	644,000	90.0	7,151	60	386,400
	Hay .....tons.	94,000	1.30	73,000	13 00	1,138,000
	Total	.....	.....	274,482	.....	4,084,940
.....	Indian corn bushels	60,000	21.2	2,850	67	40,200
	Wheat ..... do ..	275,000	13.4	20,580	75	206,250
	Barley .... do ..	430,000	19.4	22,141	55	236,500
	Potatoes ..... do ..	65,000	55.0	1,180	75	48,750
	Hay ..... tons	30,000	1.20	25,000	13 50	405,000
	Total	.....	.....	71,721	.....	936,700
.....	Indian corn bushels.	13,950,000	30.0	465,000	30	4,185,000
	Wheat . ... . do .	22,330,000	14.5	1,540,200	46	10,271,800
	Rye .....do	174,000	20.3	8,575	37	61,380
	Oats .. .. do .	11,812,000	37.5	315,000	23	2,716,760
	Barley ..... . do	2,800,000	26.6	106,750	37	1,055,200
	Buckwheat .. do ..	12,000	19.5	1,100	63	7,560
	Potatoes . .... do ..	1,342,000	93.0	14,128	32	429,440
	Hay ... .tons	616,000	1.40	440,000	3 70	2,279,200
	Total	....		2,890,753	.....	21,014,340
.....	Indian corn bushels.	36,000	20.0	1,820	75	27,000
	Wheat . .. .. do .	1,120,000	18.0	59,400	72	806,400
	Rye ..... do ..	14,000	13.0	1,074	40	5,600
	Oats .....do .	1,012,000	30.0	33,750	43	435,160
	Barley. ..... do .	363,000	28.9	12,576	60	217,800
	Potatoes .....do	315,000	105.0	3,000	56	176,250
	Hay..... .....tons.	102,000	1 20	185,000	13 00	2,106,000
	Total	... .	.. ..	346,620	....	3,771,210
.....	Indian corn ..bushels	21,000	24.9	838	75	18,750
	Wheat ..... . do	1,372,000	18.0	76,240	70	960,400
	Oats ..... do .	1,740,000	33.5	52,000	35	609,000
	Barley ..... do .	74,000	34.7	2,139	60	44,400
	Potatoes ..... do .	202,000	105.0	2,781	56	183,520
	Hay .....tons .	150,000	1.0	150,000	13 00	1,950,000
	Total	.....	.....	283,990	.....	3,743,070

Table showing the product of the cereals, potatoes, hay, and cotton, &c.—Con

States.	Products.	Quantity produced in 1884.	Average yield per acre.	Number of acres in each crop.	Value per unit of quantity.	Va
New Mexico	Indian corn.. bushels..	950,000	20.1	47,200	[illegible]	
	Wheat .....do....	930,000	13.6	68,450	90	
	Oats .....do....	252,000	20.0	12,588	42	
	Barley.....do....	62,000	12.5	3,176	70	
	Potatoes.....do	33,000	70.0	477	80	
	Hay .....tons..	28,000	1.30	20,000	13 50	
	Total	.....	.....	151,886	.....	
Utah	Indian corn.. bushels..	292,000	21.7	13,473	70	
	Wheat.....do....	1,675,000	18.0	93,100	82	
	Rye.....do....	24,000	10.3	2,267	80	
	Oats .....do....	650,000	24.9	26,120	35	
	Barley.....do....	302,000	23.5	12,841	45	
	Potatoes.....do....	940,000	100.0	9,408	32	
	Hay .....tons..	168,000	1.40	[illegible]	6 50	
	Total	.....	.....	277,224	.....	
Washington	Indian corn ..bushels..	105,000	32.7	3,210	75	
	Wheat..... do....	4,118,000	12.6	326,508	60	
	Rye .....do....	24,000	16.9	1,426	65	
	Oats .....do....	2,623,000	34.9	75,100	35	
	Barley.....do....	664,000	26.4	25,296	45	
	Potatoes.....do....	1,226,000	120.0	10,218	30	
	Hay .....tons..	229,500	1.50	153,000	9 25	
	Total	.....	.....	595,326	.....	
Wyoming	Wheat .....bushels..	34,000	16.0	2,120	72	
	Oats .....do....	75,000	30.0	2,500	40	
	Potatoes.....do....	109,000	95.0	1,150	60	
	Hay .....tons..	19,500	1.30	15,000	12 50	
	Total	.....	.....	20,770	.....	

Summary for each State, showing the product, the area, and the value of each crop.

States and Territories.	Corn.			Wheat.	
	Bushels.	Acres.	Value.	Bushels.	Acres.
Maine	1,062,000	30,610	$796,500	629,000	41,905
New Hampshire	1,286,000	58,774	977,360	171,000	11,615
Vermont	1,909,000	60,282	1,299,350	365,000	21,789
Massachusetts	1,941,000	57,097	1,397,520	19,000	1,070
Rhode Island	390,000	12,818	304,200	.....	.....
Connecticut	1,768,000	57,000	1,149,200	36,000	2,193
New York	22,674,000	753,810	13,604,400	12,720,000	772,722
New Jersey	10,992,000	343,500	5,935,080	2,022,000	135,540
Pennsylvania	43,406,000	1,403,000	22,602,320	20,820,000	1,533,600
Delaware	3,075,000	214,450	1,700,250	1,407,000	94,700
Maryland	15,237,000	698,400	7,314,760	8,260,000	644,960
Virginia	29,480,000	1,936,391	16,508,800	7,455,000	930,200
North Carolina	31,499,000	2,519,927	18,899,400	4,050,000	707,290
South Carolina	13,320,000	1,444,020	9,057,600	1,410,000	231,810
Georgia	30,925,000	2,857,700	21,647,500	3,130,000	487,500
Florida	3,837,000	403,913	3,069,600	.....	.....
Alabama	30,107,000	2,322,885	18,420,170	1,575,000	278,450
Mississippi	25,510,000	1,889,600	15,810,200	239,000	48,060
Louisiana	11,007,000	865,450	7,374,600	.....	.....
Texas	60,290,000	3,752,700	37,379,800	5,561,000	556,000
Arkansas	32,465,000	1,757,710	17,531,100	1,885,000	249,450
Tennessee	65,723,000	3,245,082	29,575,350	9,320,000	1,330,230
West Virginia	11,900,000	594,115	6,664,000	3,318,000	316,425
Kentucky	71,880,000	3,258,410	30,908,400	13,425,000	1,372,000
Ohio	85,393,000	2,846,064	35,011,130	41,186,000	2,691,936
Michigan	28,022,000	929,388	10,408,800	20,772,000	1,804,365
Indiana	104,757,000	3,612,312	35,617,380	32,745,000	2,708,016
Illinois	244,544,000	8,151,469	76,809,640	32,374,000	2,700,900

for each State, showing the product, the area, and the value, &c.—Continued.

Territories.	Corn.			Wheat		
	Bushels.	Acres.	Value.	Bushels.	Acres.	Value.
.....	26, 200, 000	1 066, 625	$8, 908, 000	20, 083. 000	1, 434, 510	$12, 049, 800
.....	23 490, 000	705, 310	7 797, 000	41, 307, 000	2, 753. 816	20, 653, 500
.....	252 000, 000	7, 320, 652	58. 098, 000	31, 270, 000	2. 605. 771	17, 198, 500
.....	197 856 000	5, 995, 931	51 441, 000	27 500, 000	2, 334. 706	17, 050, 000
.....	168. 500 000	4. 565, 000	37, 070 000	34 900, 000	2. 120 500	15, 745, 500
.....	122. 100 000	3, 23 >, 298	21, 978, 000	28, 025, 000	1, 950, 290	11. 896, 50%
.....	4, 800 000	160, 000	2, 880 000	44. 320, 000	3, 360, 000	31, 910, 400
.....	18+ 000	5, 890	101 680	15, 462. 000	858 924	7, 421, 760
.....	21 000	830	14, 280	104. 000	5, 515	104, 000
.....	710, 000	27 300	461, 500	2, 348. 000	117 420	1, 314. 880
.....	80, 000	2 850	40, 200	275. 000	20, 5?0	206, 250
.....	13, 950, 000	465, 000	4, 185, 000	22, 330 000	1, 540, 200	10, 271, 800
.....	36, 000	1 520	27, 000	1, 120, 000	59, 400	806, 400
.....	21, 000	830	15, 750	1, 372, 000	76, 210	960, 400
.....	950, 000	47 200	646. 000	930, 000	68, 450	837 000
.....	292 000	13, 473	204, 400	1, 075, 000	93. 100	1, 378. 500
.....	105. 000	3, 210	78, 750	4, 118, 000	326, 366	2, 470, 800
.....	....	.....	.....	34. 000	2, 120	24, 820
.....	1 795. 528, 000	69, 683, 780	640, 735, 560	512, 766, 000	30. 475, 885	330, 962, 260

Territories.	Oats.			Rye.		
	Bushels.	Acres.	Value.	Bushels.	Acres.	Value.
.....	2, 425, 000	83, 733	$1, 044, 040	32, 000	2, 409	$28, 800
dre	99. , 000	30, 588	446, 850	30, 000	3, 313	26, 400
.....	3. 625, 000	103 530	1, 450, 000	88, 000	6, 354	62, 480
[s	717 000	23, 500	322, 650	393, 000	25, 306	213, 330
.....	101 000	5 882	75. 070	16, 000	1, 386	12, 000
.....	1, 112. 000	37 512	407 040	353, 000	20, 393	254, 160
.....	41, 145 000	1, 371 5ad	14, 4 0, 7 0	2, 650, 000	239, 266	1, 609, 500
.....	2, 735. 000	1,? 564	1, 011, 950	1 024, 000	103, 518	686, 060
.....	35, 027, 000	1, 253 866	12, 259, 450	4, 000, 000	405, 241	2, 617, 000
.....	482, 000	16. 580	168, 700	7, 000	857	4, 550
.....	1, 980, 000	110. 000	693 000	321, 000	29, 294	208, 650
.....	6, 418, 000	621 230	2, 695. 560	328, 000	51, 845	219, 760
th	4, 622. 000	617, 646	2, 126. 120	367, 000	65, 551	293, 000
a	3, 5?3 000	394. 250	1, 772 500	92, 000	8, 285	32, 000
.....	6, 270, 000	702. 614	3, 573. 900	145, 000	27, 085	174, 000
.....	494. 000	52 560	296 400	.....	.....	.....
.....	5, 015. 000	405 830	2 758, 250	33, 000	6, 050	41, 250
.....	3, 048. 000	348 040	1, 737, 360	5, 000	640	6, 000
.....	404. 000	35, 110	2?4. 320	8, 000	1, 260	9, 600
.....	10, ,27 000	478 510	4, 421 340	59, 000	5, 544	40, 120
.....	1, 54_ 000	228 44 ?	1, 5?6, 900	28, 000	4, 198	29, 400
.....	7, 680 000	568 8. 5	3, 221 000	209, 000	30, 137	146, 300
h	2, 212 000	130 2	862, 680	153, 000	18 106	114, 750
.....	1, 5?5 000	427 430	2 742, 750	846, 000	96, 254	507, 600
.....	23 4 9 000	830, 400	6, 791, 5.0	327, 000	36. 860	183, 120
.....	19, 980, 000	507 864	5, 797 100	233, 000	22, 802	132, 810
.....	21, 742. 000	724 736	5. 870. 340	256. 000	25, 511	138, 240
.....	98, 1?3. 000	2, 060 983	22. 75. 190	4, 890 000	302, 120	2, 301, 120
.....	45, 940, 000	1, 371, 354	11 ?2?. 600	2, 468, 000	174, 418	1, 110, 600
.....	30, 1 ? 000	1. 025, 136	7, 220. 000	476, 000	32, 069	185, 640
.....	78, 050, 000	2, 14?, 959	15, 730, 000	1, 494, 000	123, 747	544, 920
.....	30 774 000	1, 1 ?2, 500	7, 693, 500	558, 000	50, 054	294, 000
.....	27 410. 000	783, 413	6, 032, 180	5, 042, 000	293, 515	1, 704, 700
.....	21, 844, 000	648, 193	4, 150 360	1, 098, 000	67, 385	351, 360
.....	2, 149, 000	79, 600	816. 620	314, 000	30 409	213, 520
.....	5, 470, 000	195, 350	1, 641 000	22, 000	1, 338	14, 300
.....	251, 000	7, 858	145, 580	.....	.....	.....
.....	1, 516, 000	43, 312	600, 400	33, 000	1, 872	19, 800
.....	11, 812, 000	315 000	2 716, 760	174, 000	8, 575	84, 360
.....	1, 012, 000	33 750	435, 160	14, 000	1, 074	5, 600
.....	1, 740, 000	52 000	669, 000	.....	.....	.....
.....	252, 000	12, 583	105. 840	.....	.....	.....
.....	650, 000	20, 120	227, 500	24, 000	2, 287	14, 400
.....	2, 623, 000	75, 100	918, 050	24, 000	1, 426	15, 600
.....	75, 000	2, 500	30, 000	.....	.....	.....
.....	583, 628, 000	21, 300, 917	161, 523, 470	28, 640, 000	2, 343, 963	14, 857, 040

Summary for each State, showing the product, the area, and the value, &c.—Continued.

States and Territories.	Barley.			Buckwheat.		
	Bushels.	Acres.	Value.	Bushels.	Acres.	Va
Maine	265,000	13,180	$193,450	360,000	21,185	$
New Hampshire	76,000	3,745	57,760	77,000	4,600	
Vermont	265,000	11,481	177,580	301,000	17,202	
Massachusetts	75,000	3,248	63,750	87,000	5,389	
Rhode Island	20,000	834	17,200	1,000	126	
Connecticut	14,000	632	10,500	134,000	11,067	
New York	7,987,000	354,085	5,251,020	4,349,000	206,350	3,
New Jersey	4,000	254	2,720	445,000	35,026	
Pennsylvania	573,000	20,729	378,180	3,207,000	258,916	1,
Delaware				7,000	437	
Maryland	7,000	252	4,900	135,000	10,679	
Virginia	17,000	1,183	11,900	205,000	16,567	
North Carolina	3,000	208	2,550	49,000	5,006	
South Carolina	18,000	1,312	18,000			
Georgia	22,000	1,606	23,100			
Alabama	7,000	649	7,700			
Texas	124,000	7,836	86,300			
Tennessee	46,000	3,061	33,120	33,000	5,393	
West Virginia	11,000	567	8,250	383,000	32,776	
Kentucky	459,000	20,594	275,400	12,000	1,225	
Ohio	985,000	36,894	600,850	96,000	11,360	
Michigan	1,101,000	50,857	627,570	441,000	33,491	
Indiana	443,000	20,530	259,710	80,000	6,566	
Illinois	962,000	41,779	500,820	148,000	15,226	
Wisconsin	7,299,000	314,610	3,430,590	322,000	36,032	
Minnesota	8,087,000	334,183	2,830,450	68,000	6,249	
Iowa	4,951,000	221,999	1,732,850	210,000	20,077	
Missouri	178,000	8,242	106,800	70,000	6,014	
Kansas	550,000	21,613	183,480	21,000	1,709	
Nebraska	3,551,000	168,714	1,171,830	24,000	2,130	
California	16,217,000	688,045	8,432,840	28,000	1,219	
Oregon	1,239,000	84,500	582,330	9,000	561	
Nevada	688,000	24,497	550,400			
Colorado	188,000	6,867	107,160			
Arizona	430,000	22,141	230,500			
Dakota	2,860,000	100,750	1,058,200	12,000	1,100	
Idaho	363,000	12,576	217,800			
Montana	74,000	2,130	44,400			
New Mexico	62,000	3,176	43,400			
Utah	302,000	12,641	135,900			
Washington	694,000	25,696	307,800			
Total	61,203,000	2,008,618	29,779,170	11,116,000	870,468	

States and Territories.	Potatoes.			Hay.	
	Bushels.	Acres.	Value.	Tons.	Acres.
Maine	5,842,000	60,228	$2,687,320	1,029,760	1,082,95
New Hampshire	2,568,000	27,034	1,181,280	585,058	615,85
Vermont	3,482,000	35,528	1,323,160	956,238	955,2
Massachusetts	3,154,000	31,910	2,050,100	550,133	611,2
Rhode Island	641,000	6,490	450,100	60,657	60,6
Connecticut	2,555,000	31,344	1,533,000	459,706	574,7
New York	33,904,000	360,682	18,222,560	5,458,374	4,962,1
New Jersey	3,450,000	40,114	1,897,500	616,020	514,
Pennsylvania	16,397,000	192,202	6,371,420	3,283,748	3,711,
Delaware	230,000	4,141	182,300	48,655	48,
Maryland	1,412,000	20,176	706,000	311,872	283,5
Virginia	2,061,000	34,350	1,133,550	360,389	281,8
North Carolina	1,360,000	19,997	666,000	105,828	81,4
South Carolina	224,000	3,725	179,200	3,789	2,9
Georgia	615,000	9,175	639,500	19,608	18,1
Florida	180,000	1,988	198,000	274	
Alabama	630,000	9,081	630,000	15,059	10,0
Mississippi	596,000	8,805	520,260	12,513	
Louisiana	472,000	6,956	396,480	47,810	
Texas	560,000	8,708	537,700	84,782	
Arkansas	875,000	12,147	568,750	32,178	
Tennessee	2,390,000	38,581	1,195,000	217,816	72
West Virginia	1,893,000	26,291	984,360	250,840	9
Kentucky	3,728,000	51,067	1,491,200	351,000	9
Ohio	13,490,000	161,199	5,077,800	2,185,000	2,450,0

for each State, showing the product, the area, and the value, &c.—**Continued.**

Territories.	Potatoes.			Hay.		
	Bushels.	Acres.	Value.	Tons.	Acres.	Value.
.....	13,192,000	146,582	$3,298,000	1,741,027	1,243,591	$16,975,013
.....	7,015,000	92,305	2,455,250	2,016,000	1,440,000	14,716,800
.....	10,699,000	135,427	3,637,660	4,025,000	2,875,000	25,116,000
.....	9,800,000	108,985	2,550,340	2,122,944	1,633,034	18,162,253
.....	5,579,000	61,310	1,506,330	2,730,000	1,950,000	12,098,900
.....	12,518,000	137,563	3,505,040	5,062,500	3,750,000	21,262,500
.....	6,653,000	78,275	2,195,490	1,625,000	1,250,000	10,237,500
.....	7,402,000	85,085	3,330,900	4,940,000	3,800,000	20,896,200
.....	4,309,000	47,356	1,249,610	2,567,500	1,975,000	8,934,900
.....	5,573,000	58,664	3,343,300	1,395,000	930,000	14,382,450
.....	1,385,000	12,587	415,500	525,000	350,000	5,250,000
.....	371,000	4,640	259,700	195,000	150,000	1,618,500
.....	644,000	7,151	386,400	94,900	73,000	1,138,800
.....	65,000	1,180	48,750	30,000	25,000	405,000
.....	1,342,000	14,128	429,440	616,000	440,000	2,279,200
.....	315,000	3,000	173,250	162,000	135,000	2,106,000
.....	292,000	2,781	163,520	150,000	150,000	1,950,000
.....	37,000	477	26,400	26,000	20,000	351,000
.....	940,000	9,403	310,200	168,000	120,000	1,092,000
.....	1,226,000	10,218	367,800	229,500	153,000	2,145,825
.....	159,000	1,150	65,400	19,500	15,000	248,750
.....	190,642,000	2,220,980	75,534,290	48,470,460	38,871,593	396,130,909

Territories.	Tobacco.			Cotton.		
	Pounds.	Acres.	Value.	Bales.	Acres.	Value.
ire	136,000	96	$16,048	.....	.....	.....
s	3,715,000	2,730	453,230	.....	.....	.....
.....	9,481,000	8,064	1,175,644	.....	.....	.....
.....	8,162,000	5,386	979,440	.....	.....	.....
.....	34,143,000	25,991	3,585,015	.....	.....	.....
.....	31,255,000	41,811	2,281,615	.....	.....	.....
.....	99,763,000	149,495	7,382,462	18,500	46,302	$598,[illegible]
ia	84,858,000	69,600	4,008,070	404,100	1,061,048	17,663,211
ia	.....	.....	.....	511,800	1,716,128	22,227,986
.....	.....	.....	.....	807,400	2,958,930	35,141,278
.....	.....	.....	.....	57,300	268,111	3,151,500
.....	.....	.....	.....	648,700	2,740,941	29,862,905
.....	.....	.....	.....	883,200	2,392,447	39,426,048
.....	.....	.....	.....	485,200	922,581	21,426,432
.....	.....	.....	.....	995,400	3,186,668	45,330,516
.....	1,111,000	2,185	83,325	531,400	1,259,858	23,711,068
.....	31,392,000	45,048	2,197,440	313,800	815,678	14,153,949
ia	2,341,000	4,149	224,928	.....	.....	.....
.....	208,692,000	276,139	15,651,900	.....	.....	.....
.....	29,349,000	35,983	2,113,128	.....	.....	.....
.....	9,318,000	12,812	624,306	.....	.....	.....
.....	3,014,000	5,736	276,080	.....	.....	.....
.....	14,360,000	14,663	1,404,720	.....	.....	.....
.....	15,810,000	16,170	1,204,560	.....	.....	.....
ites and Ter- cluding Mis- otton	3,672,000	8,610	440,640	30,200	70,920	1,304,640
.....	541,504,000	724,668	44,160,151	5,682,000	17,439,612	253,993,385

Table showing the average yield per acre and the price per bushel, pound, or ton, of products for the year 1884.

States and Territories.	Corn.		Wheat.		Rye.		Oats.		Barley.	
	Bushels.	Price per bushel.	Bushels.	Price per bushel.	Bushels.	Price per bushel.	Bushels.	Price per bushel.	Bushels.	Price per bushel.
Maine	34.7	$0 75	15.0	$1 25	13.3	$0 90	29.0	$0 43	21.8	$0
New Hampshire	33.2	76	14.7	1 20	9.1	88	32.5	45	20.3	
Vermont	33.2	65	16.8	1 05	13.8	71	35.0	40	23.1	
Massachusetts	34.0	72	17.8	1 12	15.5	81	30.4	45	23.1	
Rhode Island	30.4	78	.....	.....	11.5	75	27.4	47	24.3	
Connecticut	31.0	65	16.4	1 00	12.0	72	29.6	42	22.2	
New York	30.1	60	16.5	85	11.1	63	30.0	35	22.5	
New Jersey	32.0	54	13.0	90	9.9	67	21.1	37	15.7	
Pennsylvania	31.0	52	13.6	86	10.1	64	27.9	35	21.4	
Delaware	18.5	43	10.6	85	8.2	65	23.4	35	.....	...
Maryland	21.8	48	12.8	83	11.0	65	18.0	35	27.8	
Virginia	15.2	56	8.0	80	6.3	67	10.3	42	14.6	
North Carolina	12.5	60	6.1	89	5.6	80	7.5	46	11.2	
South Carolina	9.2	68	6.1	1 05	3.9	1 00	9.0	50	14.9	1
Georgia	10.8	70	6.4	1 05	5.4	1 20	8.9	57	13.2	1
Florida	9.5	80	.....	.....	.....	.....	9.4	60	.....	...
Alabama	13.0	61	6.0	1 00	5.4	1 25	12.4	55	10.8	1
Mississippi	13.5	62	5.0	1 00	6.0	1 20	8.8	57	.....	...
Louisiana	12.7	67	.....	.....	6.3	1 20	11.5	58	.....	...
Texas	16.1	62	10.0	87	10.6	68	22.0	42	15.8	
Arkansas	18.5	54	7.6	93	6.7	05	15.5	45	.....	...
Tennessee	20.3	45	7.0	75	5.8	1 70	18.5	42	14.9	
West Virginia	20.0	56	10.5	80	8.5	75	17.0	39	19.4	
Kentucky	22.1	43	10.6	74	8.8	60	18.4	35	22.3	
Ohio	30.0	41	15.3	75	8.9	56	28.0	29	26.7	
Michigan	28.0	40	16.5	74	10.2	57	33.4	29	21.6	
Indiana	29.0	34	12.5	67	10.0	54	30.0	27	21.6	
Illinois	30.0	31	11.6	63	16.2	47	32.8	23	23.5	
Wisconsin	24.6	34	14.0	60	14.1	45	33.5	24	23.2	
Minnesota	33.5	33	15.0	50	14.8	39	35.2	20	24.2	
Iowa	34.5	23	12.0	55	11.6	38	36.7	20	22.3	
Missouri	33.0	26	11.8	62	11.7	50	26.7	25	21.6	
Kansas	36.9	22	16.5	45	17.2	35	35.0	22	25.7	
Nebraska	37.7	18	14.5	42	16.3	32	33.7	19	21.0	
California	30.0	60	13.2	72	10.3	68	27.0	38	23.6	
Oregon	27.8	62	18.0	48	16.4	65	28.0	30	35.9	
Nevada	25.3	68	18.9	1 00	.....	.....	31.9	58	28.1	
Colorado	28.1	65	20.0	56	17.6	60	35.0	40	29.5	
Arizona	21.1	67	13.4	75	.....	.....	.....	.....	19.4	
Dakota	30.0	30	14.5	46	20.3	37	37.5	23	26.8	
Idaho	19.8	75	18.9	72	13.0	40	30.0	43	28.9	
Montana	25.3	75	18.0	70	.....	.....	33.5	35	34.6	
New Mexico	20.1	68	13.6	90	.....	.....	20.0	42	19.5	
Utah	21.7	70	18.0	82	10.5	60	24.9	35	23.5	
Washington	32.7	75	12.6	60	16.8	65	34.9	35	26.4	
Wyoming	.....	.....	16.0	73	.....	.....	30.0	40	.....	...
Average	25.8	35.7	13.0	64.5	12.2	51.9	27.4	28	23.5	

States and Territories.	Buckwheat.		Potatoes.		Hay.		Tobacco.		Cotton.	
	Bushels.	Price per bushel.	Bushels.	Price per bushel.	Tons.	Price per ton.	Pounds.	Price per pound.	Bales.	P
								Cents.		C
Maine	17.0	$0 55	97	$0 46	.95	$12 25	.....	.....	.....	...
New Hampshire	16.4	60	95	46	.95	13 00	1,417	11.8	.....	...
Vermont	16.9	65	98	38	1.00	12 00	.....	.....	.....	...
Massachusetts	16.1	80	93	65	.90	17 50	1,361	12.2	.....	...
Rhode Island	7.9	80	99	70	1.00	17 30	.....	.....	.....	...
Connecticut	12.1	70	81	60	.80	17 00	1,176	12.4	.....	...
New York	13.8	56	94	39	1.10	12 50	1,515	12.0	.....	...
New Jersey	12.7	65	86	55	1.20	14 75	.....	.....	.....	...
Pennsylvania	12.4	58	85	39	1.20	12 00	1,314	10.5	.....	...
Delaware	16.0	55	57	56	1.00	14 00	.....	.....	.....	...
Maryland	12.6	70	70	50	1.10	12 95	748	7.8	.....	...
Virginia	12.4	70	60	55	1.30	12 00	667	7.4	.20	
North Carolina	8.8	70	63	55	1.30	10 60	501	11.5	.38	
South Carolina	.....	.....	60	80	1.30	12 70	.....	.....	.30	
Georgia	.....	.....	8	1 04	1.30	13 30	.....	.....	.27	

owing the average yield per acre and the price per bushel, pound, or ton, of farm products for the year 1884—Continued.

nd Territories.	Buckwheat.		Potatoes.		Hay.		Tobacco.		Cotton.	
	Bushels.	Price per bushel.	Bushels.	Price per bushel.	Tons.	Price per ton.	Pounds.	Price per pound.	Bales.	Price per pound.
								Cents.		*Cents.*
.....	.....	.....	90	$1 10	1.30	$19 00	.....	.....	.21	*9.1
.....	.....	.....	70	1 00	1.20	13 40	.....	.....	.24	9.3
pi	.....	.....	72	87	1.30	12 35	.....	.....	.37	9.8
.....	.....	.....	78	84	1.30	11 00	.....	.....	.53	9.2
.....	.....	.....	65	95	1.20	10 25	.....	.....	.31	9.0
.....	.....	.....	72	65	1.30	12 75	508	7.5	.42	9.2
)	6.2	$0 68	62	50	1.20	12 00	697	7.0	.38	9.3
ginia	8.6	72	72	52	1.10	10 00	565	9.6	.....	.....
.....	9.8	70	73	40	1.30	9 75	756	7.5	.....	.....
.....	8.5	70	75	42	1.30	10 00	816	7.2	.....	.....
.....	13.2	60	90	25	1.40	9 75	.....	.....	.....	.....
.....	9.3	67	76	35	1.40	7 30	727	6.7	.....	.....
.....	9.6	67	79	34	1.40	6 24	688	7.0	.....	.....
.....	8.9	51	90	26	1.30	6 20	979	10.2	.....	.....
.....	10.7	55	91	27	1.40	4 43	.....	.....	.....	.....
.....	10.5	57	91	28	1.40	4 20	.....	.....	.....	.....
.....	11.6	60	85	33	1.30	6 30	978	7.6	.....	.....
.....	11.7	63	87	45	1.30	4 23			.....	.....
.....	11.3	55	91	29	1.30	3 48			.....	.....
.....	23.0	60	95	60	1.50	10 31			.....	.....
.....	16.0	60	110	30	1.50	10 00			.....	.....
.....	.....	.....	80	70	1.30	8 30			.....	.....
.....	.....	.....	90	60	1.30	12 00			.....	.....
.....	.....	.....	55	75	1.20	13 50			.....	.....
.....	10.9	63	95	32	1.40	3 70	426	12.0	.....	.....
.....	.....	.....	105	55	1.20	13 00			.....	.....
.....	.....	.....	105	56	1.00	13 00			.....	.....
ico.....	.....	.....	69	80	1.30	13 50			.....	.....
.....	.....	.....	100	33	1.40	6 50			.....	.....
on	.....	.....	120	30	1.50	9 35			.....	.....
.....	.....	.....	95	60	1.30	12 50			.....	.....
rage	12.6	58.9	85.8	39.6	1.26	8 17	747.2	8.2	.33	9.2

* Upland only.

le showing the average cash value per acre of farm products for the year 1884.

l Territories.	Corn.	Wheat.	Rye.	Oats.	Barley.	Buckwheat.	Potatoes.	Hay.	Tobacco.	Cotton.
.....	$26 02	$18 74	$11 96	$12 47	$15 88	$9 35	$44 62	$11 64	.....	.....
pshire	25 21	17 67	7 97	14 61	15 42	9 85	43 70	12 35	$167 17	.....
.....	21 55	17 59	9 83	14 01	15 46	10 95	37 24	12 00	.....	.....
setts..	24 48	19 89	12 58	13 69	19 63	12 92	60 45	15 75	166 02	.....
and ...	23 73	.....	8 66	12 86	20 87	6 35	69 29	17 30	.....	.....
ut	20 16	16 42	8 65	12 45	16 61	8 46	48 60	13 60	145 79	.....
.....	18 05	14 01	6 98	10 50	14 83	7 72	38 66	13 75	181 85	.....
sy.....	17 28	11 70	6 63	7 81	10 71	8 26	47 30	17 70	.....	.....
nia...	16 11	11 67	6 44	9 78	14 15	7 18	33 15	14 40	137 93	.....
.....	7 97	9 03	5 31	8 20	.....	8 81	31 91	14 00	.....	.....
.....	10 47	10 63	7 12	6 30	19 44	8 85	34 99	14 24	54 57	.....
.....	8 52	6 41	4 24	4 34	10 23	8 65	33 00	15 60	49 38	$12 83
olina..	7 50	5 39	4 48	3 44	10 63	6 13	34 66	13 78	57 60	16 65
olina..	6 27	6 39	3 86	4 50	14 85	.....	48 11	15 88	.....	12 95
.....	7 58	6 74	6 42	5 09	13 87	.....	69 71	17 29	.....	11 88
.....	7 60	.....	.....	5 64	.....	.....	99 10	24 67	.....	11 75
.....	7 93	6 02	6 81	6 80	11 86	.....	70 04	16 08	.....	10 90
pi.....	8 37	4 95	7 14	4 99	.....	.....	62 64	16 06	.....	16 48
.....	8 52	.....	7 62	6 67	.....	.....	65 48	14 30	.....	23 22
.....	9 96	8 69	7 24	9 24	11 08	.....	61 75	12 30	.....	14 23
.....	9 97	7 06	7 00	6 98	.....	.....	46 82	16 57	38 14	18 82
)	9 11	5 23	4 05	5 67	10 75	4 23	31 00	14 40	48 78	17 35
ginia ..	11 22	8 39	6 34	6 62	14 55	6 22	37 44	11 00	54 21	.....
.....	9 49	7 81	5 27	6 44	13 37	6 86	29 20	12 68	56 68	.....
.....	12 30	11 47	4 97	8 12	16 29	5 97	31 50	13 00	58 73	.....
.....	11 20	12 21	5 82	9 70	12 34	7 90	22 50	13 65	.....	.....
.....	9 86	8 35	5 42	8 10	12 30	6 26	26 60	10 22	48 73	.....

Table showing the average cash value per acre of farm products for the year 1884—Cont'd.

States and Territories.	Corn.	Wheat.	Rye.	Oats.	Barley.	Buckwheat.	Potatoes.	Hay.	Tobacco.	Cotton.
Illinois	$9 30	$7 31	$7 62	$7 55	$11 99	$6 46	$26 86	$8 74	$48 13	.....
Wisconsin	8 35	8 40	6 37	8 04	10 90	4 56	23 40	8 06	99 89	.....
Minnesota	11 06	7 50	5 79	7 04	8 47	5 89	24 57	6 20	.....	.....
Iowa	7 93	6 60	4 40	7 33	7 81	5 96	25 48	5 67	.....	.....
Missouri	8 58	7 30	5 87	6 67	12 96	6 98	28 05	8 19	74 31	.....
Kansas	8 12	7 43	6 01	7 70	8 49	7 35	39 15	5 50		
Nebraska	6 79	6 10	5 21	6 40	6 95	6 20	26 39	4 52		
California	18 00	9 50	7 02	10 26	12 26	13 78	57 00	15 47		
Oregon	17 26	8 64	10 69	8 40	16 88	9 63	33 01	15 00		
Nevada	17 20	18 86	.....	18 53	22 47	.....	55 97	10 79		
Colorado	18 24	11 20	10 58	14 00	16 83	.....	54 03	15 60		
Arizona	14 11	10 04	.....	.....	10 68	.....	41 31	16 20		
Dakota	9 00	6 67	7 51	8 62	9 91	6 87	30 40	5 15	51 18	.....
Idaho	14 84	13 58	5 21	12 89	17 32	.....	57 75	15 60		
Montana	18 98	12 60	.....	11 71	20 76	.....	58 80	18 00		
New Mexico	13 69	12 23	.....	8 41	18 66	.....	55 35	17 55		
Utah	15 17	14 75	6 30	8 71	10 58	.....	82 99	9 10		
Washington	24 53	7 57	10 94	12 22	11 89	.....	36 00	14 03		
Wyoming	.....	11 71	.....	12 00	.....	.....	56 87	16 25		
Average	9 19	8 38	6 34	7 58	11 41	7 45	31 00	10 27	60 94	14 58

A general summary showing the estimated quantities, number of acres, and aggregate value of the crops of the farm in 1884.

Products.	Quantity produced.	Number of acres.	Value.
Indian corn.....bushels..	1,795,528,000	69,683,780	$640,735,560
Wheat.....do....	512,765,000	39,475,885	330,362,260
Rye.....do....	28,640,000	2,343,963	14,857,640
Oats.....do....	583,628,000	21,300,917	161,528,420
Barley.....do....	61,203,000	2,608,818	29,779,170
Buckwheat.....do....	11,116,000	879,403	6,542,620
Potatoes.....do....	190,642,000	2,220,980	75,524,280
Total.....	3,183,522,000	138,513,746	1,259,835,550
Hay.....tons..	48,470,460	38,571,593	396,139,260
Tobacco.....pounds..	541,504,000	724,668	44,160,152
Cotton.....bales..	5,682,000	17,439,612	253,998,295
Grand total.....	.....	195,249,619	1,954,132,855

Table showing the average yield and cash value per acre, and price per unit of quantity of farm products for the year 1884.

Products.	Average yield per acre.	Average price per unit of quantity.	Average value per acre.	Products.	Average yield per acre.	Average price per unit of quantity.	Average value per acre.
Indian corn.bushels.	25.8	$0 35.7	$9 19	Buckwheat.bushels.	12.6	$0 58.9	$7 45
Wheat.....do....	13.0	64.5	8 38	Potatoes.....do ..	85.8	39.6	34 00
Rye.....do....	12.2	51.9	6 34	Hay.....tons..	1.26	8 17	10 27
Oats.....do....	27.4	28.0	7 58	Tobacco...pounds..	747.2	8.2	60 94
Barley.....do....	23.5	48.7	11 41	Cotton.....bales..	.33	*9.2	14 58

* Per pound.

FARM ANIMALS.

y the estimated number of animals on farms, total value of each kind, and average price, January, 1896.

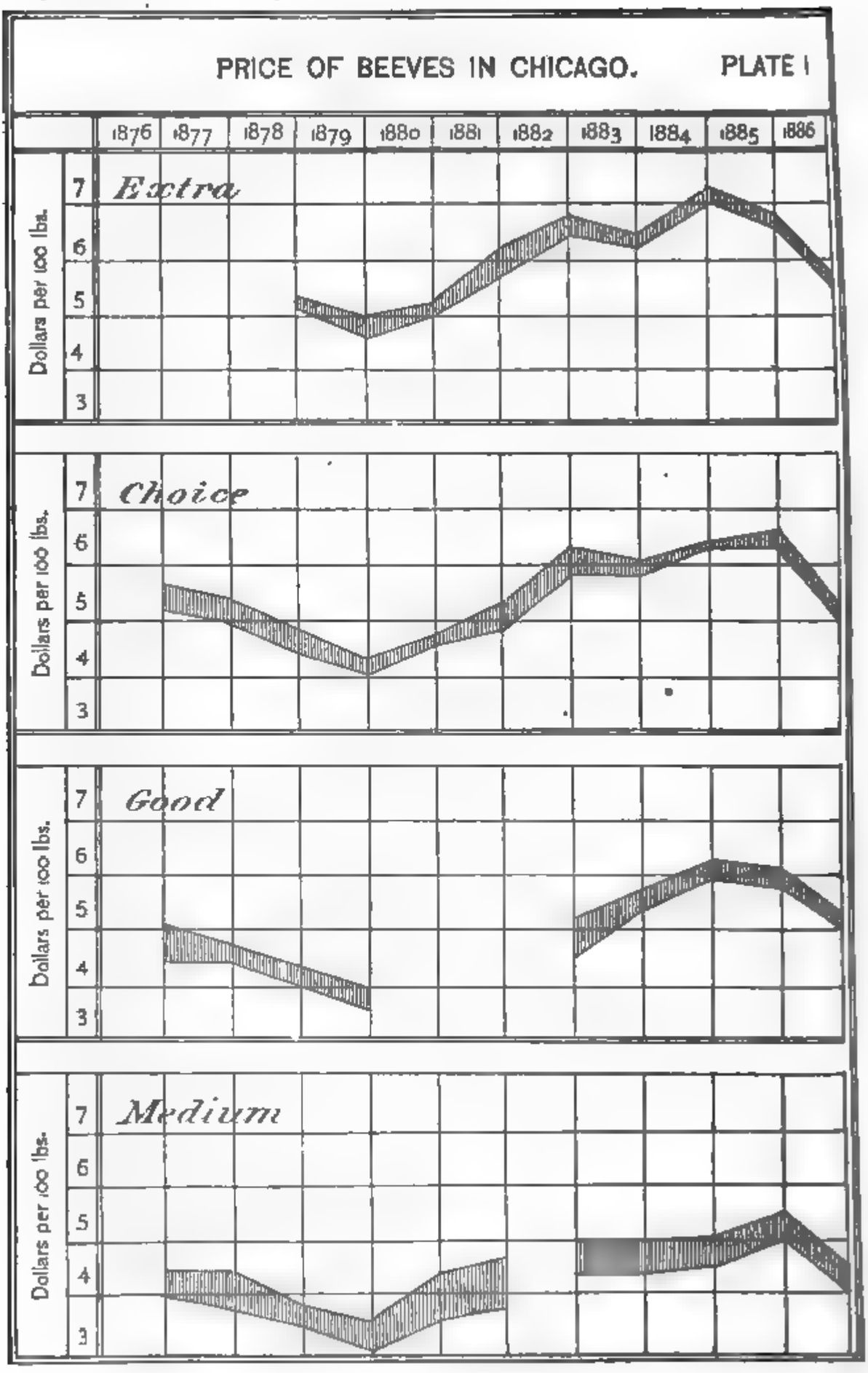
Territories.	Horses.			Mules.		
	Number.	Average price.	Value.	Number.	Average price.	Value.
.....	89, 304	$99 19	$7, 973, 061	304	$90 43	$38, 275
.....	49, 139	86 74	4, 262, 220	.....	.....	.....
.....	77, 649	81 56	6, 332, 052	.....	.....	.....
.....	62, 043	104 06	6, 457, 480	.....	.....	.....
.....	9, 897	105 17	1, 031, 402	.....	.....	.....
.....	47, 459	99 38	4, 711, 780	.....	.....	.....
.....	638, 142	100 26	63, 742, 551	6, 197	111 67	679, [illegible]
.....	69, 843	103 70	3, 316, 719	9, 314	121 66	1, 130, [illegible]
.....	574, 656	97 14	55, 822, 276	23, 909	111 35	2, 662, 267
.....	22, 109	98 82	2, 187 022	4, 021	113 59	456, 745
.....	125, 264	84 19	10, 549, 292	12, 967	112 29	1 456, 064
.....	229, 285	73 37	16, 868, 497	34, 942	99 63	3, 657 135
.....	141, 167	77 71	10, 970, 085	64, 596	84 47	7, 230, [illegible]
.....	92, 167	65 18	5, 917, 055	70, 415	101 21	7, 126, 702
.....	105, 776	83 80	8, 736, 040	148, 643	96 68	13, 754, [illegible]
.....	28, 563	68 22	2, 523, 360	11, 540	100 37	1, 160, 070
.....	120, 994	71 02	8, 589, 223	121, 033	96 49	11, 338, 477
.....	122, 700	73 80	8, 993, 910	144, 620	91 69	13, 260, [illegible]
.....	111, 856	58 09	6, 500, 385	75, 530	86 13	6, 455, 495
.....	923, 516	40 56	37, 454 074	104, 093	87 09	9, 448, 201
.....	166, 280	60 13	9, 999, 539	106, 528	69 04	7, 376, 000
.....	262, 945	70 39	19, 862, 739	183, 537	78 36	14, 018, 539
.....	139, 040	69 66	8, 907, 531	6, 349	77 69	489, 444
.....	371, 879	66 40	25, 496, 455	116, 961	70 49	8, 277, 500
.....	726, 902	80 04	50, 141, 716	21, 817	69 91	1, 941, 961
.....	420, 245	85 37	35, 876, 816	5, 713	100 10	569, 000
.....	616, 856	77 32	47, 693, 306	64, 300	85 63	4, 598, 189
.....	1, 038, 375	75 55	78, 449, 231	125, 780	84 70	10, 649, 821
.....	386, 922	77 13	29, 997, 554	8, 091	93 57	747, 369
.....	318, 683	[illegible]	25, 706, 309	10, 054	89 52	900, 139
.....	917, 006	74 35	68, 246, 460	42, 027	89 66	4, 395, 761
.....	715, 796	59 19	42, 364, 414	196, 686	70 95	13, 957, 643
.....	533, 404	74 48	39, 727, 030	75, 824	91 50	6, 937, 696
.....	310, 381	75 46	23, 427, 558	27, 454	93 60	2, 569, 694
.....	265, 225	62 06	16, 457, 211	31, 551	94 20	2, 959, 749
.....	149, 333	55 53	8, 287, 201	2, 940	67 79	199, 444
.....	40, 506	60 76	2, 460, 740	1, 424	80 81	115, 165
.....	96, 700	56 20	5, 551, 875	7, 560	75 22	568, 933
.....	8, 901	52 00	457, 652	1, 129	70 00	79, 030
.....	117, 906	72 35	8, 532, 670	4, 240	94 55	497, 022
.....	29, 545	58 50	1, 669, 203	965	78 00	74, 490
.....	105, 000	55 81	5, 860, 050	2, 800	75 85	211, 540
.....	17, 006	37 00	678, 300	10, 400	49 18	516, 000
.....	50, 936	44 56	2, 269, 708	3, 247	82 76	268, 782
.....	73, 824	64 79	4, 783, 057	961	93 96	90, 709
.....	18, 785	45 89	862, 044	.....	.....	.....
.....	11, 564, 572	73 70	852, 282, 947	1, 972, 389	83 36	165, 497 497

Territories.	Milch cows.			Oxen and other cattle.		
	Number.	Average price.	Value.	Number.	Average price.	Value.
.....	163, 716	$32 00	$5, 238, 912	187, 690	$21 19	$3, 976, 499
.....	96, 169	33 43	3, 116, 615	198, 948	21 42	4, 262, 749
.....	225, 711	26 00	5, 868, 486	189, 415	22 36	4, 236, 206
.....	163, 451	35 00	5, 720, 085	197, 309	22 16	4, 370, 294
.....	22, 101	36 50	806, 687	18, 084	27 28	490, 697
.....	121, 006	34 57	4, 185, 278	166, 992	24 39	3, 749, 149
.....	1, 541, 122	33 00	50, 857, 026	877, 181	25 97	21, 552, 261
.....	167, 857	38 75	6, 504, 489	69, 947	25 87	2, 495, 988
.....	893, 185	34 05	30, 413, 290	675, 994	20 55	26, 761, 617
.....	29, 399	33 56	961, 267	26, 605	29 96	835, 681
.....	126, 493	34 06	4, 308, 762	129, 593	27 74	3, 872, 283
.....	247, 897	24 31	6, 034, 182	422, 432	20 78	8, 988, 252
.....	241, 369	17 00	4, 103, 273	427, 808	11 81	5, 090, 395

Table showing the estimated number of animals on farms, &c.—Continued.

States and Territories.	Milch cows.			Oxen and other cattle.		
	Number.	Average price.	Value.	Number.	Average price.	Value.
South Carolina	141,806	$18 50	$2,625,076	216,880	$10 96	$2,377,005
Georgia	344,458	17 50	6,028,015	610,811	10 75	6,566,210
Florida	46,075	14 67	680,123	565,600	8 89	5,028,184
Alabama	282,465	16 00	4,519,440	432,090	10 07	4,299,206
Mississippi	272,081	16 83	4,570,123	416,294	10 46	4,354,435
Louisiana	148,848	18 20	2,709,034	258,023	12 65	3,263,991
Texas	700,876	24 00	16,821,024	4,234,923	12 77	66,784,736
Arkansas	268,062	20 22	5,420,214	429,294	12 63	5,421,993
Tennessee	320,017	23 51	7,523,360	466,084	16 03	7,471,327
West Virginia	164,606	29 00	4,773,574	289,519	23 37	6,766,850
Kentucky	304,720	33 21	10,119,751	503,977	26 90	13,554,284
Ohio	763,560	33 47	26,225,753	1,017,820	29 40	29,923,995
Michigan	416,200	35 00	14,567,000	501,628	28 19	14,[illegible]
Indiana	530,033	33 34	17,671,300	876,896	28 08	24,
Illinois	919,004	34 86	32,036,479	1,471,191	28 67	42,
Wisconsin	548,716	30 44	16,702,916	710,058	24 67	17,
Minnesota	384,496	20 83	10,872,916	439,697	24 53	10
Iowa	1,150,182	30 00	34,505,460	2,014,494	26 23	52
Missouri	688,056	27 00	18,577,512	1,321,731	22 50	29,
Kansas	537,472	31 00	16,661,632	1,423,104	25 61	36,
Nebraska	286,209	30 00	8,586,270	1,505,350	26 14	39,
California	231,743	38 50	8,922,106	615,595	30 38	18,
Oregon	68,897	28 00	1,920,116	551,663	27 04	14
Nevada	16,350	40 00	654,000	240,196	27 57	6
Colorado	48,719	40 00	1,948,760	849,816	26 68	22,
Arizona	13,188	31 00	408,828	217,210	21 00	4,561,41
Dakota	108,590	29 00	3,149,110	419,450	26 23	11,
Idaho	20,621	40 00	824,840	223,178	27 00	6,
Montana	23,000	40 00	920,000	615,000	28 17	17,
New Mexico	17,580	27 00	474,660	959,881	18 83	18,074,52
Utah	40,012	34 00	1,360,408	145,898	24 49	3,560,79
Washington	51,108	33 50	1,712,118	253,414	27 54	6,979,03
Wyoming	5,666	38 00	215,308	914,940	25 21	23,065,65
Indian Territory				570,000	25 00	14,250,00
Total	12,904,723	29 70	412,908,098	29,806,573	23 25	694,382,83

States and Territories.	Sheep.			Hogs.		
	Number.	Average price.	Value.	Number.	Average price.	Value.
Maine	548,374	$2 34	$1,283,195	71,416	$5 79	$407,74
New Hampshire	201,299	2 54	511,299	54,404	10 13	551,11
Vermont	385,892	2 96	1,142,240	74,115	8 36	619,69
Massachusetts	67,959	3 51	238,536	81,701	12 42	1,014,73
Rhode Island	20,866	3 79	79,082	14,640	11 24	166,08
Connecticut	59,419	3 68	218,662	62,406	9 92	619,09
New York	1,697,685	3 47	5,890,967	736,796	8 53	6,284,87
New Jersey	119,348	3 99	476,199	206,165	9 70	1,999,28
Pennsylvania	1,486,851	3 10	4,609,238	1,114,536	8 49	9,463,41
Delaware	22,549	3 46	77,916	44,431	8 20	364,33
Maryland	172,022	3 65	627,880	309,142	6 29	1,944,58
Virginia	477,450	2 62	1,250,919	795,687	4 30	3,421,45
North Carolina	488,350	1 37	669,040	1,432,509	4 04	5,787,30
South Carolina	117,041	1 76	207,048	567,181	4 14	2,348,12
Georgia	532,547	1 49	793,405	1,597,927	3 46	5,529,98
Florida	97,951	1 76	172,394	307,828	2 72	838,05
Alabama	343,925	1 47	505,570	1,351,152	3 [illegible]	4,580,49
Mississippi	281,738	1 52	428,242	1,224,388	3 25	3,979,26
Louisiana	121,234	1 68	203,673	563,874	3 33	1,877,70
Texas	7,558,461	1 95	14,738,999	2,233,091	3 64	8,130,41
Arkansas	225,020	1 64	369,033	1,659,181	3 36	5,574,05
Tennessee	635,558	1 79	1,137,649	2,021,568	4 02	8,126,78
West Virginia	637,665	2 23	1,421,998	416,153	4 18	1,739,64
Kentucky	950,761	2 66	2,529,024	2,052,665	4 73	9,709,15
Ohio	4,900,035	2 50	12,250,088	2,467,128	5 39	13,297,68
Michigan	2,364,174	2 69	6,350,628	849,174	6 07	5,154,46
Indiana	1,122,182	2 38	2,670,793	2,801,211	5 63	15,770,81
Illinois	1,003,101	2 41	2,634,373	4,090,681	5 34	21,435,13
Wisconsin	1,282,947	2 19	2,809,654	1,066,234	5 62	6,318,23
Minnesota	272,708	2 56	698,132	421,202	5 24	2,203,71
Iowa	[illegible]303	2 48	1,171,311	4,800,000	5 57	26,743,[illegible]


PRICE OF BEEVES IN CHICAGO.
PLATE I
1876
1877
1878
1879
1880
1881
1882
1883
1884
1885
1886
Dollars per 100 lbs.
7
6
5
4
3
Extra
Choice
Good
Medium

showing the estimated number of animals on farms, &c.—Continued.

Territories.	Sheep.			Hogs.		
	Number.	Average price.	Value.	Number.	Average price.	Value.
.....	1,338,623	$1 79	$2,396,135	4,210,193	$4 02	$16,924,976
.....	838,143	1 93	1,617,616	2,208,911	6 19	13,673,159
.....	373,894	2 11	788,916	1,679,200	6 25	10,495,000
.....	5,892,911	1 89	11,137,602	978,665	5 80	5,676,257
.....	2,519,950	1 61	4,057,120	187,843	3 76	706,200
.....	423,885	1 92	813,859	14,256	6 73	95,943
.....	1,185,942	1 86	2,205,852	14,193	8 93	126,743
.....	853,335	1 90	1,621,337	9,853	6 30	62,074
.....	183,820	2 39	439,330	177,990	5 78	1,028,782
.....	191,250	2 30	439,875	26,762	9 00	240,858
.....	625,000	2 46	1,537,500	19,298	9 80	189,120
.....	5,410,944	1 64	8,873,948	24,988	7 10	177,415
.....	620,730	2 12	1,315,948	26,242	9 28	243,526
.....	533,871	2 38	1,270,623	63,599	7 70	489,712
.....	609,960	2 08	1,268,717	.....	.....	.....
.....	50,360,243	2 14	107,960,650	45,142,657	5 02	226,401,683

ri of farm animals are made in January of each year, in
:e prices by counties are returned, and changes in num-
ılly estimated percentages, which are consolidated into
i or numbers and averages of prices for each State and Ter-

es and numbers, as returned in January, 1886, see tables in
with the crops of 1885, at the close of this report.

MARKET PRICES OF CATTLE.

Prices of beeves in Chicago.

e of beef cattle reached the highest point in 1882, when, on
June, in Chicago, "extra beeves" sold at from $9.15 to $9.40
of live weight, and "choice" were quoted at $8.65 to $8.90.
y 1, 1879, when the upward course of meat values began, the
the same grades were, respectively, $4.60 to $5.00 and $4.10

owing table presents the record of prices on the 1st day of
or the last eleven years:

Years.	Extra.	Choice.	Good.	Medium.
.....	.....	$5 25 to $5 75	$4 50 to $5 10	$4 00 to $4 50
.....	.....	5 00 5 50	4 50 4 80	3 80 4 40
.....	$5 15 to $5 40	4 50 4 90	4 00 4 40	3 50 3 85
.....	4 60 5 00	4 10 4 35	3 60 4 00	3 00 3 50
.....	5 00 5 25	4 60 4 75	.....	*3 50 4 40
.....	5 75 6 25	4 85 5 40	.....	*3 75 4 65
.....	6 50 6 85	5 85 6 35	4 50 5 15	.....
.....	6 25 6 50	5 80 6 10	5 40 5 70	4 40 5 00
.....	7 00 7 25	6 30 6 40	6 00 6 25	4 50 5 00
.....	6 65 6 85	6 25 6 60	5 75 6 10	5 00 5 50
.....	5 17 5 70	4 30 5 00	3 85 4 55	3 50 4 15

* Good to medium includes two grades.

January 1, 1884, was higher than at the beginning of any
he series. There was little variation during 1884, the
.50 in February and $6.60 in May for "extra."

Price of Chicago beeves, 1885.

Months.	Extra.	Choice.	Good.	Medi
January	$6 65 to $6 85	$6 25 to $6 60	$5 75 to $6 10	$5 00 t
February	6 50 6 60	6 00 6 40	5 40 5 90	4 35
March	5 75 6 30	5 75	4 75 5 25	4 25
April	5 00 5 75	4 75 5 00	4 75 5 00	4 25
May	5 40 5 75	5 50 5 60	5 25 5 40	4 85
June	5 75 5 85	5 50 5 65	5 25 5 40	4 90
July	6 00 6 20	5 00 5 70	4 80 5 25	3 00
August	5 25 5 90	4 25 5 50	4 00 5 00	4 00
September	5 90 6 00	5 50 5 80	5 00 5 40	3 90
October	5 90 6 05	5 30 5 87½	5 00 5 50	4 00
November	5 00 5 80	5 10 5 55	4 20 5 00	3 30
December	5 75 6 00	5 35 5 70	4 40 5 20	3 40

The movement to which these prices refer is as follows:

	Receipts.	Shi
Cattle.....number	1,905,518	
Calves.....do	58,500	
Hogs.....do	6,937,535	
Sheep.....do	1,003,608	
Horses.....do	19,358	

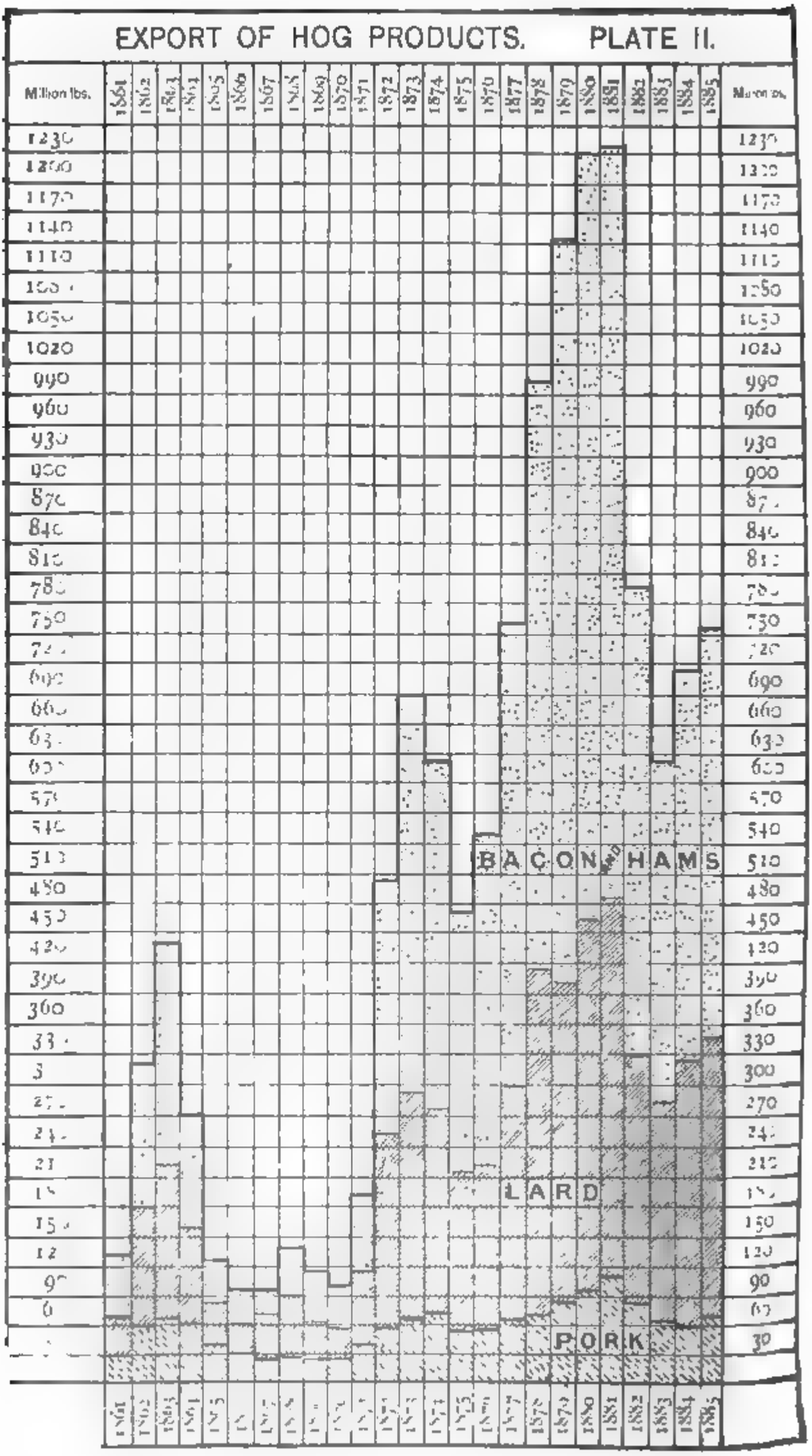
Prices of cattle in Kansas City, 1885.

Months.	Native cows.	Native steers.	Native s
January	$2 50 to $3 60	$3 60 to $4 25	$4 35
February	2 50 3 50	4 00	4 70
March	3 25 3 75	4 25 4 35	4 32½
April	2 65 4 25	4 10 4 50	4 15
May	3 00 4 00	3 50 4 55	4 60
June	3 55 4 35	4 40 4 65	4 65
July	2 50 4 00	3 25 4 90	5 00
August	2 25 4 00	4 15 4 25	4 50
September	2 00 3 65	3 95	4 25
October	2 00 3 00	2 50	4 25
November	2 00 2 80	3 80 4 30	4 35
December	2 25 3 25	3 45 3 85	3 75

SWINE BREEDING IN AMERICA.

The swine-breeding industry is a very important branch of Am agriculture. The numbers in summer are in recent years about 43,0 to 45,000,000, or four-fifths as many as the inhabitants of the U States, and the number annually slaughtered are now about 28,0 which is less by 1,000,000 or 2,000,000 than four years ago. The tation has declined to the extent of 2,000,000 in that time.

While the numbers are about 80 to 100 of the population i country, the enumeration in Europe gives only about 15 to 100 of lation. This shows how relatively small is the European consum how easily the supply may become a glut, and how seriously an in of production in those countries may affect the demand for Am pork.


EXPORT OF HOG PRODUCTS. PLATE II.
Million lbs.
1230
1200
1170
1140
1110
1080
1050
1020
990
960
930
900
870
840
810
780
750
720
690
660
630
600
570
540
510
480
450
420
390
360
330
300
270
240
210
180
150
120
90
60
30
1861
1862
1863
1864
1865
1866
1867
1868
1869
1870
1871
1872
1873
1874
1875
1876
1877
1878
1879
1880
1881
1882
1883
1884
1885
BACON & HAMS
LARD
PORK

wing table shows the numbers of swine in European coun-

ries.	Years.	Swine.	Countries.	Years.	Swine.
.....	1880	2,731,541	Netherlands	1882	408,618
.....	1880	4,180,127	Portugal	1882	971,585
.....	1880	646,375	Roumania	1878	837,600
.....	1881	527,417	Russia in Europe	1877	16,839,093
.....	[illegible]	5,566,620	Servia	1882	1,067,940
.....	1883	9,206,791	Spain	1876	2,848,602
.....	1884	2,584,891	Finland	1880	154,238
.....	1884	1,806,195	Sweden	1882	480,646
.....	1884	15,619	Norway	1875	101,020
.....	1875	179,603	Switzerland	1876	894,515
.....	1881	1,163,916			

aordinary increase of our exportation in the last half of the
n 1871 to 1880 was due to the harvest failures of that period
and the uniformly large corn crops of this country. The re-
greater aggregate value of exports in five years than in the
from 1821 to 1870. The exhibit is as follows:

ılues of exports of hogs and hog products, by decades, 1821 to 1881.

	Dollars.	Years.	Dollars.	Years.	Dollars.
...	1,354,116	1841	2,621,587	1861	12,190,731
...	1,357,899	1842	2,629,403	1862	24,208,609
...	1,291,822	1843	2,110,020	1863	38,844,088
...	1,489,051	1844	2,236,470	1864	29,498,992
...	1,512,679	1845	2,901,288	1865	26,4[illegible]
...	1,892,429	1846	3,883,884	1866	17,0[illegible]
...	1,555,698	1847	6,630,642	1867	13,5[illegible]
...	1,495,830	1848	9,008,272	1868	18,1[illegible]
...	1,493,629	1849	9,245,885	1869*	18,5[illegible]
...	1,315,245	1850	7,550,287	1870	15,4[illegible]
...	15,077,598	Total	49,902,859	Total	[illegible]
...	1,501,644	1851	4,383,015	1871	23,0[illegible]
...	1,928,[illegible]06	1852	3,765,470	1872	45,974,[illegible]
...	2,151,[illegible]58	1853	6,202,324	1873	62,062,[illegible]
...	1,796,601	1854	11,061,016	1874	60,126,470
...	1,776,732	1855	11,607,185	1875	57,9[illegible]3,845
...	1,383,344	1856	12,770,548	1876	68,508,[illegible]05
...	1,299,796	1857	12,467,029	1877	82,070,671
...	1,312,340	1858	9,430,272	1878	86,947,[illegible]28
...	1,777,[illegible]30	1859	8,438,069	1879	79,438,[illegible]26
...	1,894,894	1860	10,329,618	1880	85,269,[illegible]31
...	16,821,741	Total	90,439,424	Total	651,264,976

*Not including hogs; live animals not being separately given.

.rst twenty years in this long period the advance was slow,
e aggregate value in no year fell below $1,000,000. A marked
n is observed in the latter part of the third decade, followed
rary retrograde, and that by a few years of larger exporta-
fourth. In the last twenty years, however, the development
tion has been phenomenal.

e nual exportation for twenty-five years, including hogs
ts, has been 530,000,000 pounds. If 200 pounds be
ave ge cured product of a hog, as it is very nearly, the
t of hogs for exportation has been 2,650,000. The

annual home consumption of pork products during the same p averaged 3,000,000,000 pounds, as an investigation of the mos hensive data relating to the subject shows. This makes the production of twenty-five years 3,530,000,000, of which the ex has been 15 per cent. The present consumption, at 70 pound inhabitant, is about 4,000,000,000. To avoid error, as to the slaughtered, it should be observed that the average weight slaughtered by farmers is much less than that of the pack average weight of all swine slaughtered is estimated at a pounds.

In the table of products exported during the last twenty-f the fluctuation in prices is remarkable. As a rule, the lower the larger the quantity exported.

Quantity of products exported.

Years ended June 30—	Live hogs.		Bacon and hams.		Lard.		P
	Number.	Price per head.	Pounds.	Price per pound.	Pounds.	Price per pound.	Pounds
				Cents.		Cents.	
1861.....	463	$7 06	50,264,267	9.6	47,906,911	9.9	31,297,
1862.....	3,306	7 13	141,312,786	7.3	118,573,307	8.4	61,220,
1863.....	9,467	10 18	218,343,609	8.5	155,330,596	10.1	65,570,
1864.....	9,190	9 45	110,886,446	11.1	97,190,765	11.6	65,519,
1865.....	1,400	9 12	45,990,712	22.0	44,342,205	20.5	41,
1866.....	951	16 25	37,588,930	16.7	30,110,451	19.8	30,
1867.....	3,577	11 21	25,648,226	12.8	45,608,031	14.5	37
1868.....	1,399	13 19	43,650,064	12.5	64,565,462	14.6	
1869*.....	.....	.....	49,226,165	15.3	41,887,545	17.8	
1870.....	12,058	15 74	38,968,256	15.7	35,808,580	16.6	24,
1871.....	8,770	7 00	71,446,854	11.4	80,037,297	12.2	32,
1872.....	56,110	9 77	246,208,143	8.6	199,651,660	10.1	57,
1873.....	99,720	7 90	395,381,737	8.9	280,534,207	9.3	64,
1874.....	168,681	10 25	347,405,405	9.6	205,527,471	9.4	70,
1875.....	64,979	11 38	250,286,549	11.4	166,869,393	13.7	56,
1876.....	68,044	9 85	327,730,172	12.1	168,405,830	13.3	64
1877.....	65,107	10 74	460,057,146	10.8	234,741,238	10.9	69
1878.....	29,284	9 13	502,814,351	8.7	342,667,920	[illegible]	71
1879.....	75,129	9 32	732,249,576	7.0	326,656,696	7.0	84,
1880.....	83,434	5 05	769,773,109	6.7	374,979,286	7.4	96
1881.....	77,456	7 39	746,944,545	8.2	378,142,495	9.3	107
1882.....	30,368	14 01	468,026,640	10.0	250,367,740	11.6	
1883.....	16,129	16 90	340,258,670	11.2	234,718,474	11.6	
1884.....	46,382	13 53	389,499,368	10.2	265,094,719	[illegible]	
1885.....	55,025	10 58	400,127,119	9.3	283,216,339	8.0	71,
Total.	992,388	.....	7,189,899,845	.....	4,412,934,653	.....	1,444

* Animals not separately enumerated in 1869.
† Not including 185,417 pounds of fresh pork.
‡ Not including 424,103 pounds of fresh pork.

THE WHEAT DISTRIBUTION.

The wheat crop of 1884 was about five times as large as th 1850. The production of wheat has increased during this perio twice as fast as population. It has been stimulated by three p causes: (1) The possession of large areas of fresh lands, easily into cultivation; (2) the extension of railroad construction; recently) a period of several years of poor crops in [illegible]ern Eu the return of accustomed European yield[illegible]s the d

n declined in consequence, the markets were surfeited, prices luced, and farmers wondered what was the matter with the wheat

xpected has arrived. The prediction has been fulfilled. Wheat 1885 at the lowest figure in England for one hundred and twenty-rs. Ten years ago the farmers were told, in Department reports, erproduction and low prices were inevitable, unless more promi-hould be given to other crops. Eighteen years ago, in the sta- report for October, it was said of the Northwest: "Cattle are price, horses very high, milk is scarce, and butter sometimes n, while straw-stacks are burning, and the wheat at the mercy ulators and the railroads, and bringing high prices only under se of God upon foreign wheat fields, and when foreign nations anger of famine, and even then but a moiety of the supply comes is country."

much? From 1826 to 1860 the average export in wheat and flour 38,012 bushels annually. For eight years after that date, under nulus of the premium on gold, the average rose to 36,569,985 . Then the deficient European harvests of later years gave ex-enlarged breadth of our wheat fields, till the exportation reached ,214 bushels in 1880–'81, the largest year's shipment, followed in four years by a greatly reduced movement, an average reduc-58,000,000 bushels, and the demoralization of prices, farmers still ng the area of wheat, heedless of the warning from Europe.

nain factor in recent heavy exportation has been a series of par-p failures in Western Europe. When a period of larger yield ; ushered in an era of reduced importation. There are two pos-enues of relief to our grain-growers: a famine in Europe, or a on of acreage. If they wait for the former low prices may con-me years longer.

xportation of eight years past, 1,118,288,472 bushels, is nearly ne as for the entire fifty-one preceding years, which equaled 8,673 bushels, and yet, so variable is the demand, that the annual nts have differed 90,000,000 bushels in two years. The effect of certainty is disastrous to all calculations of price and profit; it alous, in producing high prices for some of our heaviest crops r prices for some of the worst yields on record.

t years ago, as a result of careful and repeated investigation and s of local distribution, the estimated average consumption was t $4\frac{2}{3}$ bushels per annum. The amount used for seed was also d by investigation by counties, and added to the consumption for A third element in the distribution was the quantity exported. hree items made an aggregate only 10,000,000 bushels less than mate of the year 1877. It is a bold test of the accuracy of these ncerning distribution, as also of the verity of our annual esti-f production, to apply the same methods and ratios to the com- of production and distribution of the subsequent years of the It can scarcely be possible that error, if one exists, either in s of consumption, or the annual estimate of production, will fail itself in eight years, if indeed it should not be apparent in a . The estimates are made in advance of the distribution, and y knowledge of what the exportation will be, and by methods onnected with the facts of distribution.

ng table shows how the movement of wheat tallies with production, the food supply being calculated at the above

rate, except for the year 1881, when a fourth of a bushel was ded for lessened consumption under scarcity and high prices:

Years.	Production.	For food.	For seed.	Exportation.	Total ti
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bu*
1877*	364, 194, 146	228, 302, 383	40, 913, 308	90, 167, 959	35
1878	420, 122, 400	228, 877, 978	48, 162, 340	147, 687, 649	42
1879	459, 479, 505	236, 182, 103	53, 145, 076	180, 304, 180	46
1880	498, 549, 868	242, 086, 655	56, 563, 530	186, 321, 214	48
1881	383, 280, 090	235, 249, 812	55, 215, 573	121, 892, 389	41
1882	504, 185, 470	255, 500, 000	52, 770, 312	147, 811, 316	4
1883	421, 086, 160	259, 500, 000	54, 683, 389	111, 534, 162	4
1884	512, 763, 900	265, 000, 000	55, 266, 239	132, 570, 367	4
Total	3, 563, 661, 539	1, 945, 698, 931	416, 720, 267	1, 118, 289, 256	3, 4
Average	445, 457, 692	243, 212, 366	52, 090, 034	139, 786, 157	4

*It should be understood that the exportation figures here given are those of 1877–'78, f 1, 1877, to June 30, 1878, these exports being derived almost entirely from the crop harvest So with other years. Inexperienced handlers of these figures frequently confuse these f instance, it has been repeatedly stated that 186,321,214 bushels was the quantity exported very small crop of 1881, 383,280,090 bushels, when, in fact, the export from that crop was 1 bushels, a reduction of 60,000,000 bushels.

The total distribution of eight years on this basis is only 83, less than the aggregate of the annual estimates for the same The minimum surplus on hand at the end of a crop year, visible visible, is rarely less than 50,000,000, and the maximum is s over 100,000,000. The surplus in 1885 is much larger than that at the commencement of the period in 1877, probably as u 100,000,000, or 50,000,000 more than at the beginning of the pe eight years, accounting for all of the difference between producti distribution except 33,000,000 bushels, a barely sufficient all losses by fire, shipwreck, and a small amount fed or used in n If consumption, therefore, requires a barrel of flour per num inhabitant, as an average, though the quantity varies in du the country, there is not a bushel of excess in these esti tion. Not a bushel is allowed for spirits or other manu or for feeding of domestic animals. The estimates are therefo servative, too low rather than too high; and any lower estimates utterly fail to account for the facts of distribution.

PRODUCTION AND EXPORTATION.

The production of ten years, 1870 to 1879, inclusive, average 152,728 bushels, including flour as wheat. The increase was mally rapid during this period, under the pressure of the exce European demand of its later years. The average annual expo was 84,592,377 bushels, the last year of the period showing double the annual average for the ten years. During the suc five years, 1880 to 1884, inclusive, the average exportation was by 48.6 per cent., the volume reaching the high figure of 140, bushels. The production for this period averages 463,973,098 b The accompanying diagram illustrates this great advance.

EFFECT OF PRODUCT ON PRICE.

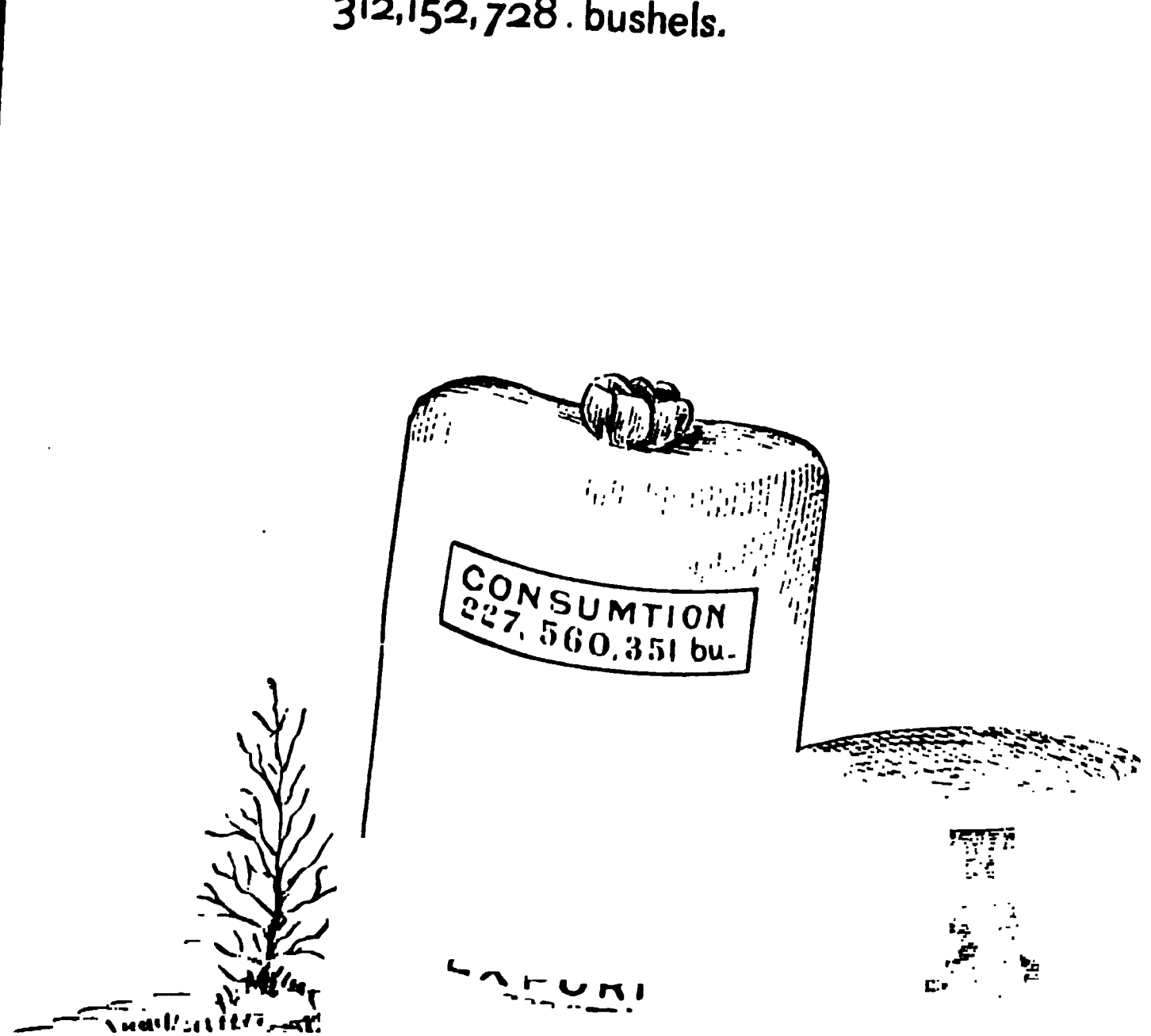
Diagram IV illustrates the operation of the law of supply mand, by comparing the yield per acre (which represents subst the supply) with the farm value per bushel of the crop of e from 1880 to 1885, inclusive. It is curious as well as suggesti the supply is increased the price falls, with prompt obedience

WHEAT PRODUCTION AND EXPORTATION.

PLATE III.

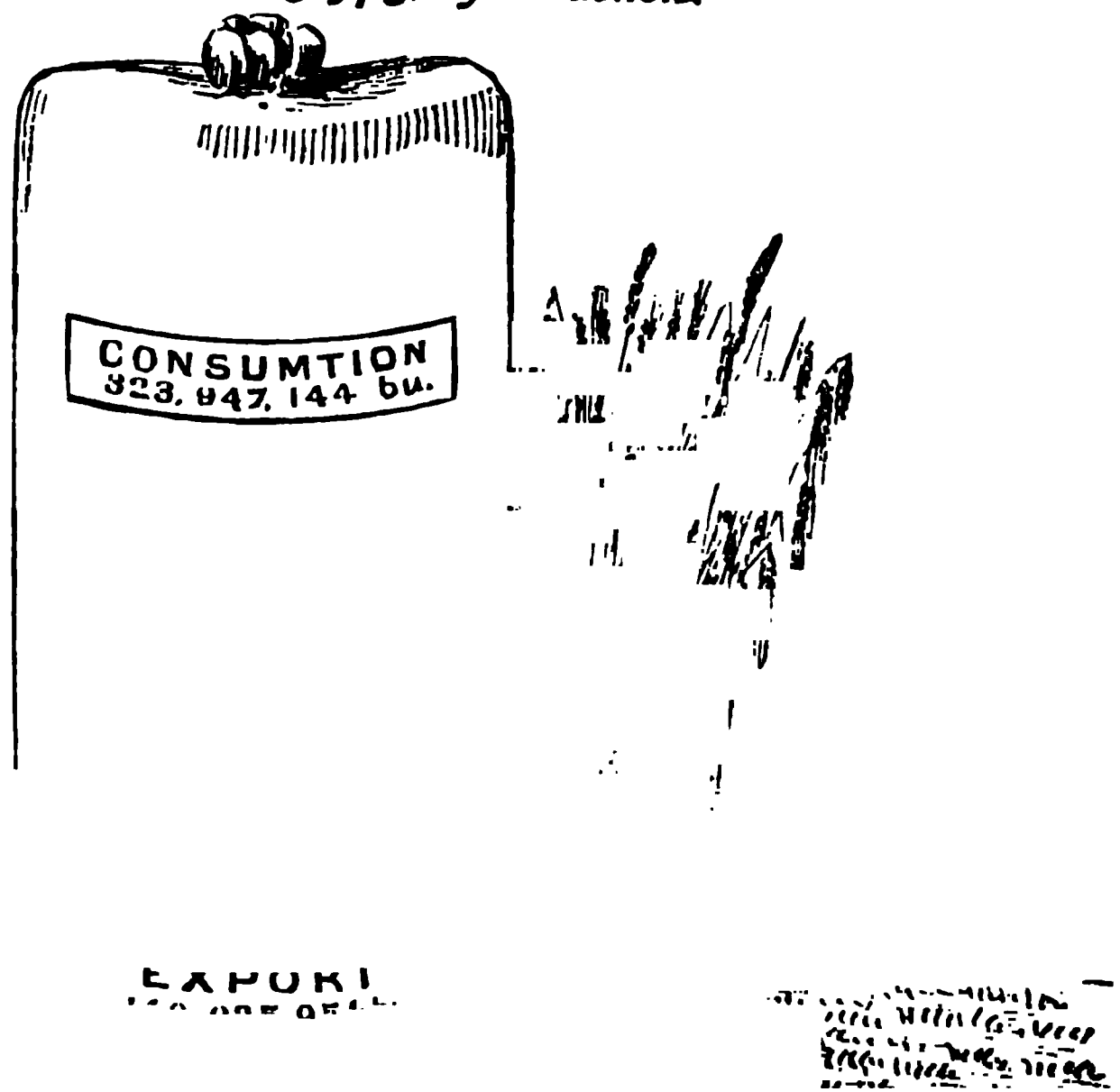
Average Annual Production, 1870-79.

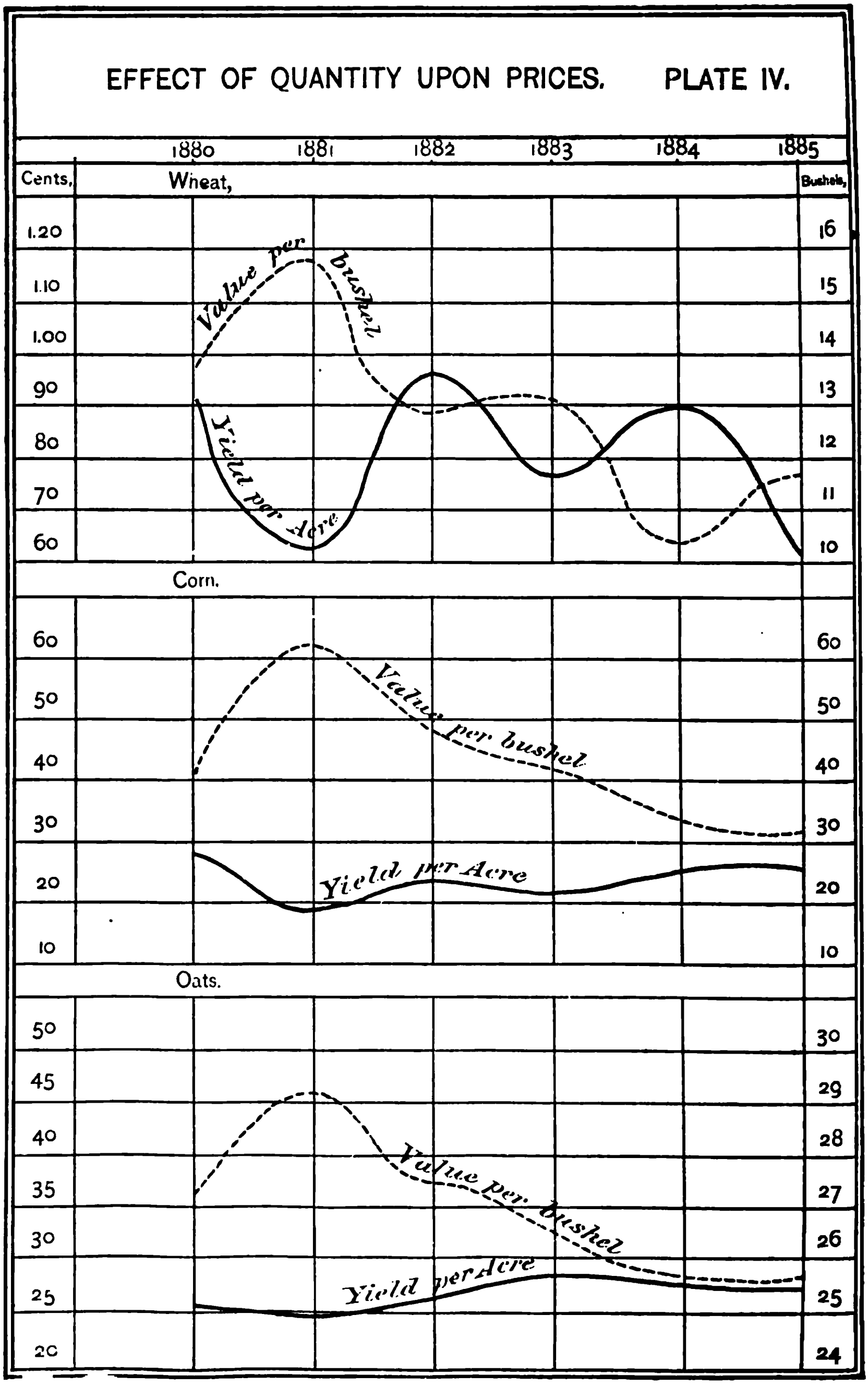
312,152,728. bushels.



Average Annual Production, 1880-84.

463,973,098 bushels.




EFFECT OF QUANTITY UPON PRICES. PLATE IV.
1880
1881
1882
1883
1884
1885
Cents.
Wheat,
Bushels.
1.20
1.10
1.00
90
80
70
60
16
15
14
13
12
11
10
Value per bushel
Yield per Acre
Corn.
60
50
40
30
20
10
60
50
40
30
20
10
Value per bushel
Yield per Acre
Oats.
50
45
40
35
30
25
20
30
29
28
27
26
25
24
Value per bushel
Yield per Acre

quantity. A glance at the diagram shows clearly this fact, e of wheat very strikingly, as a very low yield is instantly re- by a high valuation. But there is a crossing of lines and of figures for two or three years past that demand explana- s due to the fact that the changes in the world's supply, in international wheat pool, do not correspond with the annual of our crops. Thus our crop of 1885 was very small, while gate supply of the world was large. No such irregularities n corn or oats, because the foreign demand is small and for- etition almost inoperative. We make our own prices for corn while Liverpool has much to do with the price of wheat. ures on which the diagram is based are as follows:

Years.	Corn.		Wheat.		Oats.	
	Yield per acre.	Price per bushel.	Yield per acre.	Price per bushel.	Yield per acre.	Price per bushel.
.....	27.6	39.6	18.1	95.1	25.8	36.0
.....	18.6	68.6	10.2	119.3	24.7	46.4
.....	24.6	48.4	13.6	88.2	26.4	37.5
.....	22.7	42.4	11.6	91.0	28.1	33.0
.....	25.8	35.7	13.0	64.5	27.4	28.0
.....	26.5	38.0	10.4	77.1	27.2	33.0

INCREASE OF WHEAT YIELD.

owing statement is from a letter of the Statistician to Prof. J. P. f Cornell University, in response to inquiries on this subject:

se to your inquiries I may give a few facts tending to show the increase eld of wheat, the principal food-grain of countries of high civilization, as progressive and scientific agriculture. It is a very significant fact that s of high natural fertility of virgin soils show the lowest rates of yield, ils of countries, long cultivated under systematic and enlightened meth- uch higher returns. Thus in Australasia the rate of yield is about 12 acre, as in this country. In India the average is about 9 bushels.

Europe, the average of Russia may be said to be 6 to 7 bushels, produced cultivation in the rich soils of the black-earth belt and in other sections. of the valley of the Danube differs little from the average yield of this he average of Portugal is usually placed at about 13 bushels.

hen a series of good wheat seasons had been enjoyed in Europe, an inter- tistical commission fixed upon the following average rates of yield for ies of Europe that furnished statisical data to determine them:

n.....	29.9	Saxe-Weimar.....	17.2
urg	28.7	France.....	17.1
.....	27.9	Baden	16.9
.....	27.0	Wurtemberg	16.6
.....	24.8	Roumania.....	13.8
.....	23.3	Portugal	13.2
.....	19.5	Hungary	12.6
.....	17.8		

irteenth century, according to J. E. Thorold Rogers, the rate of yield, ble and not accurately determined, was not thought to exceed a quarter . Arthur Young, in 1770, made the average in England 23 bushels per r James Caird, in 1850, 26¼ bushels. Though the yield is given in the of the commission at 29.9 bushels, Sir James Caird, in 1868, thought 28 the real average. There was a large yield for several years afterward, there was a period of low yield, scarcely equal to the average of Ire- ls.

, according to Alexander Moreau de Jonnes, in his *Statistique de l'Agri- ance*, the average yield was 8 hectoliters per hectare, or a little more els per acre. In 1873, over 11 bushels; in 1840, 14 bushels. It may be the yield per acre in France is now very nearly double the rate two

hundred years ago. It is not much over half a century since the average rat passed the present yield in this country.

Evidence from Russia is not very explicit, though its tenor is favorable increase of rate of yield. It has conditions much like our own, large ar and cheap lands, which tend to prevent rapid change of rate, while the improvement are in active movement locally. As to this country, the a not materially increased for the whole area, because that area is geo changing. It is shifting from east to west and to northwest, taking in fi lands and giving up to grass and other crops a part of the more eastern acr on the whole, it is not so much abandonment of older areas as the taking ern lands in the increase of breadth. This change perpetuates substa original conditions, and keeps the average nearly the same, viz, about 12 acre for a series of years throughout the entire breadth in wheat.

I find no evidence that the yield is decreasing in this country. In a gi the spring-wheat region, the rate will increase for a year or two after bre begin to decline, not from soil exhaustion, but from preoccupation of t weeds. Yet there is evidence that the rate of yield is increasing in Western Southern Michigan, and the wheat counties of Ohio, Indiana, and Illin Maryland, where some semblance of rotation exists and cultivation has so of a scientific basis. In those regions the average is already about the France, and is 20 to 50 per cent. higher than the general average. In 187 above mentioned averaged about 18 bushels per acre, while spring wheat, after year amid weeds and without any real cultivation of the soil, only bushels per acre.

THE POTATOES OF THE WORLD.

The importance of potatoes as an article of food, and the r their production as well as their consumption to grain product it all the more desirable to treat of the statistics of this farm since, on account of the present excellent means of transporta beginning to be a considerable factor in international comm may be seen in the following table, the import of potatoes is large item in the food supply of England, of Switzerland, a United States. On the other hand, the export from Gern France is always quite large, and of late years rapidly on the

This table is given on the authority of the eminent statist F. X. Von Neumann-Spallart:

Countries.	Average of past years.		Years.	Recent
	Metric tons.	Millions of hectoliters.		Metric to
Germany	21,863,000	252.75	1881	25
Russia	12,110,000	140.00	1881	14
France	11,295,948	130.59	1882	8
Austria	7,208,910	83.34	1882	7,
United States	4,593,910	53.11	1882	5,211,
Ireland	3,539,750	41.50	.....	5,638,
Great Britain	2,772,325	32.05	1878	
Belgium	2,279,000	26.35	1881	2,204,
Hungary	1,681,314	19.42	1882	3,694,
Sweden	1,600,000	18.57	1882	1,580,
Spain	1,585,200	18.33	(†)	1,585,
Netherlands	1,491,641	17.24	1881	1,973,
Italy	704,988	8.14	1876–'81	704,
Norway	630,412	7.29	1875	618,
Finland	380,000	4.401	1881	388,
Denmark	362,309	4.19	1881	361,
Australian colonies	292,967	3.39	1881	
Portugal	280,692	3.24	(†)	
Total	74,729,586	863.90	.....	81,976,

NOTE.—1 metric ton=2,204.6 pounds. 1 hectoliter=2.8375 bushels.

According to the figures for areas in potato culture, the lat years been considerably expanded in almost all countries

AGRICULTURAL EXPORTS AND IMPORTS.

A BALANCE-SHEET.

Exports of the products of domestic agriculture, 1884 *and* 1885.

Articles.	1884.		1885.	
	Quantities.	Value.	Quantities.	Value.
Animals, living:				
Cattle ..... number..	190,518	$17,855,495	135,890	$12,906,690
Hogs .....do....	46,382	627,480	55,025	579,183
Horses .....do....	2,721	424,317	1,947	377,692
Mules .....do....	3,742	490,809	1,028	127,580
Sheep .....do....	273,874	850,146	234,509	512,568
All other, and fowls	.....	45,282	.....	63,368
Animal matter:				
Bones, hoofs, horns, and horn-tips, strips, and waste.....	.....	199,242	.....	157,973
Casings for sausages.....	.....	499,134	.....	642,364
Eggs.....dozen..	295,484	62,759	240,768	51,832
Glue.....pounds..	222,313	36,386	235,575	34,988
Grease, grease-scraps, and all soap-stock..	.....	715,650	.....	772,855
Hair, and manufactures of	.....	640,939	.....	571,290
Hides and skins, other than furs	.....	1,304,829	.....	1,822,058
Honey.....	.....	68,764	.....	224,212
Oils:				
Lard .....gallons..	712,696	504,218	916,157	555,426
Other animal .....do....	159,496	150,118	106,793	75,836
Provisions (comprising meat and dairy products):				
Meat products—				
Beef products—				
Beef, canned.....	.....	3,173,767	.....	4,214,791
Beef, fresh .....pounds..	120,784,064	11,987,331	115,780,830	11,199,481
Beef, salted or pickled .....do....	42,379,911	3,202,275	48,143,711	3,619,145
Beef, other cured .....do....	641,163	67,758	572,427	73,895
Tallow .....do....	63,091,103	4,793,375	50,431,719	3,322,476
Mutton .....do....	2,932,855	282,087	3,355,660	324,099
Oleomargarine—				
Imitation butter.....do....	1,537,682	171,119	761,938	92,779
The oil .....do....	37,785,159	4,671,243	37,120,217	4,358,853
Pork products—				
Bacon .....do....	341,579,410	33,797,430	345,924,217	31,053,174
Hams .....do....	47,919,958	5,887,415	54,202,902	6,030,774
Pork, fresh.....do....	185,417	13,057	424,103	26,807
Pork, salted or cured.....do....	60,363,313	4,749,658	71,649,365	5,177,136
Lard .....do....	265,094,719	25,805,953	283,216,339	22,595,219
Poultry and game.....do....	.....	24,336	.....	33,644
All other meat products	.....	609,492	.....	900,844
Dairy products—				
Butter .....pounds..	20,627,374	3,750,771	21,683,148	3,643,646
Cheese .....do	112,869,575	11,663,713	111,992,990	10,444,409
Milk	.....	203,008	.....	221,284
Wax, bees'.....pounds..	51,748	16,042	30,877	9,758
Wool, raw .....do....	10,393	3,073	88,006	16,739
Total value of animals and animal matter.....	.....	138,847,971	.....	126,774,868
Bread and breadstuffs:				
Barley .....bushels..	724,955	403,622	629,130	346,302
Bread and biscuit .....pounds..	17,580,740	847,671	16,471,972	702,027
Indian corn .....bushels..	45,247,490	27,648,044	51,834,416	28,003,863
Indian-corn meal .....barrels..	252,779	818,739	260,510	816,459
Oats .....bushels..	1,760,376	700,694	4,191,692	1,589,640
Oatmeal .....pounds..	27,256,427	771,471	36,205,413	1,036,011
Rye.....bushels..	6,220,206	4,323,105	2,950,558	2,000,294
Rye flour .....barrels..	4,564	18,876	3,972	15,937
Wheat .....bushels..	70,349,012	75,026,678	84,653,714	72,933,097
Wheat flour .....barrels..	9,152,260	51,139,696	10,648,145	52,146,336
All other breadstuffs and preparations of, used as food	.....	846,119	.....	780,855
Total value of bread and breadstuffs....	.....	162,544,715	.....	160,370,821

Exports of the products of domestic agriculture, 1884 *and* 1885—Continued.

Articles.	1884.		1885.	
	Quantities.	Value.	Quantities.	Val
Cotton and cotton-seed oil:				
Cotton—				
Sea Island ..... pounds..	3,598,866	$1,160,673	6,764,033	$1
Other unmanufactured ..... do....	1,858,973,664	195,854,531	1,884,895,439	20[illegible]
Cotton-seed oil ..... gallons..	3,605,946	1,570,871	6,364,279	2,6
Total value of cotton and cotton-seed oil.	.....	198,586,075	.....	204,5
Miscellaneous:				
Broom corn	.....	163,444	.....	1
Fruits:				
Apples, dried ..... pounds..	5,558,746	394,350	18,416,573	[illegible]
Apples, green or ripe ..... barrels..	105,400	422,447	668,867	[illegible]
Fruits, preserved—				
Canned	.....	495,143	.....	
Other	.....	53,361	.....	
All other, green, ripe, or dried	.....	381,117	.....	
Hay ..... tons..	16,908	309,781	11,142	
Hops ..... pounds..	13,516,643	3,265,211	7,055,289	[illegible]
Oil cake and oil-cake meal ..... do....	524,847,331	7,115,153	498,664,241	[illegible]
Oils:				
Linseed ..... gallons..	72,221	47,698	62,660	
Other vegetable	.....	37,045	.....	
Rice ..... pounds..	163,519	9,870	168,827	
Seeds:				
Clover ..... do....	27,404,737	2,730,815	17,667,925	1,
Cotton ..... do....	5,674,560	65,073	11,046,985	
Timothy ..... do....	6,836,394	370,411	3,830,737	
All other	.....	311,084	.....	
Sugar and molasses:				
Molasses and sirup ..... gallons..	5,906,005	898,966	6,749,859	
Sugar, brown ..... pounds..	202,097	14,665	161,350	
Tobacco:				
Leaf ..... do....	192,130,820	17,405,234	219,221,207	21,
Stems and trimmings ..... do....	15,026,867	360,526	11,262,439	
Vegetables:				
Onions ..... bushels..	69,494	59,682	77,103	
Peas and beans ..... do....	201,106	409,074	271,044	
Potatoes ..... do....	554,613	374,588	369,868	
Vegetables, canned	.....	155,365	.....	
All other, including pickles	.....	114,470	.....	
Wine:				
In bottles ..... dozen..	5,463	28,923	6,487	
Not in bottles ..... gallons..	83,951	65,309	79,733	
All other agricultural products	.....	277,752	.....	
Total value of miscellaneous products..	.....	36,336,557	.....	38,
RECAPITULATION.				
Total value of animals and animal matter	.....	138,847,971	.....	126,
Total value of bread and breadstuffs	.....	162,544,715	.....	160,
Total value of cotton and cotton-seed oil	.....	198,586,075	.....	204,
Total value of miscellaneous products	.....	36,336,557	.....	38,
Total agricultural exports	.....	536,315,318	.....	[illegible]
Total exports	.....	724,964,852	.....	
Per cent. of agricultural matter	.....	74	.....	

Imports of agricultural products, 1885.

Articles.	Value.
r and molasses:	
ugar	$72,519,514
olasses	4,199,296
Total sugar and molasses	76,718,810
coffee, and cocoa:	
ea	14,047,583
offee	46,723,318
ocoa	1,332,390
Total tea, coffee, and cocoa	62,103,291
als and their products:	
attle	2,313,613
ses	3,292,297
ep	897,739
other and fowls	280,123
ttles	926,749
ter	34,961
ee	964,587
	2,476,672
	1,800,093
s	20,586,443
ts—	
Preserved, &c	250,484
ll other	249,984
	330,581
imal	447
Wools	8,879,923
Total animals and their products	43,284,646
ellaneous	
Breadstuffs:	
Barley	6,522,002
Indian corn	4,002
Oats	13,707
Oatmeal	51,028
Rye	181,949
Wheat	170,290
Wheat flour	4,750
All other breadstuffs and preparations of, used as food, n. e. s	146,234
Cotton	954,760
Farinaceous substances, &c., n. e. s	595,456

Articles.	Value.
Miscellaneous.	
Flax, hemp, jute, &c. (unmanufactured)—	
Flax	$1,712,894
Hemp, and all substitutes	4,938,342
Jute	3,082,447
Sisal-grass and other vegetable substances	2,628,715
Fruits and nuts	16,705,571
Hay	1,517,840
Hops	483,706
Malt, barley	267,928
Oils, vegetable:	
Fixed or expressed—	
Olive	547,017
Other	1,543,550
Volatile or essential	917,241
Rice	2,506,418
Seed	4,496,809
Spices:	
Ground	164,080
Unground—	
Nutmegs	451,203
Pepper	1,209,367
All other	828,026
Tobacco:	
Leaf—	
Suitable for wrappers	27,314
All other	6,274,674
Vegetables.	
Beans and peas	252,395
Potatoes	255,590
Pickles and sauces	310,907
All other—	
In their natural state or in salt or brine	580,250
Prepared or preserved	442,870
Wines:	
Champagne and other sparkling	2,834,816
Still wines—	
In casks	2,341,093
In bottles	1,199,205
Total miscellaneous	67,105,228

RECAPITULATION.

r and molasses	$76,718,810
, coffee, and cocoa	62,103,291
als and their products	43,284,646
ellaneous	67,105,228
Total imports of agricultural products	249,211,975

The total exports of agricultural products in the last fiscal year were lued at the port of exportation at $530,172,835, and the imports of ducts of agriculture were valued, at foreign ports, at $249,211,975, ominal difference of $280,960,860 to the credit of the United States. the foreign valuation, and certain but indefinite undervaluations, be added the increased cost by reason of transportation and comns, so that the real balance in our favor can scarcely be more than 0,000.

u seen that, with the exception of vegetable fibers, both exports d imports consist of human food and beverages and feed of domestic s or inedible animal products. Taking from exports cotton and icles neither edible nor potable, say $205,000,000 in value, and e imports vegetable fibers and other articles valued at $15,000,000, t the value of $325,000,000 of exports and nearly $235,000,000

of imports, leaving a difference of only $90,000,000 in our favor. After foreign freight bills are paid and undervaluation deficiencies settled, there could not remain to the credit of the nation on the exchange of animal and food products a sum equal to $1 for each inhabitant.

If we take all exports, cotton included, reducing them to their value on the farm, and add to the cost of imports ocean transportation and the expenses of internal distribution, we shall find that the n of our large exportation of agricultural products is the dation of charges for imports of products of agriculture, an inc railroad earnings, and very little else. In brief, the agriculture o country is able to produce enough to supply its wants, dire exchange, as does nearly every other country in the world.

The worst aspect of this exchange is an overproduction of ucts, wheat especially, at low prices, and an underproduction sugar, for instance, and the expenditure of the proceeds of low-p wheat in the purchase of high-priced sugar.

Diagram V shows the proportions of this export t cord the official figures, without allowance for undervalu as transportation to this country, and therefore in a much mo light than these modifying considerations throw upon it.

WAGES OF FARM LABOR.

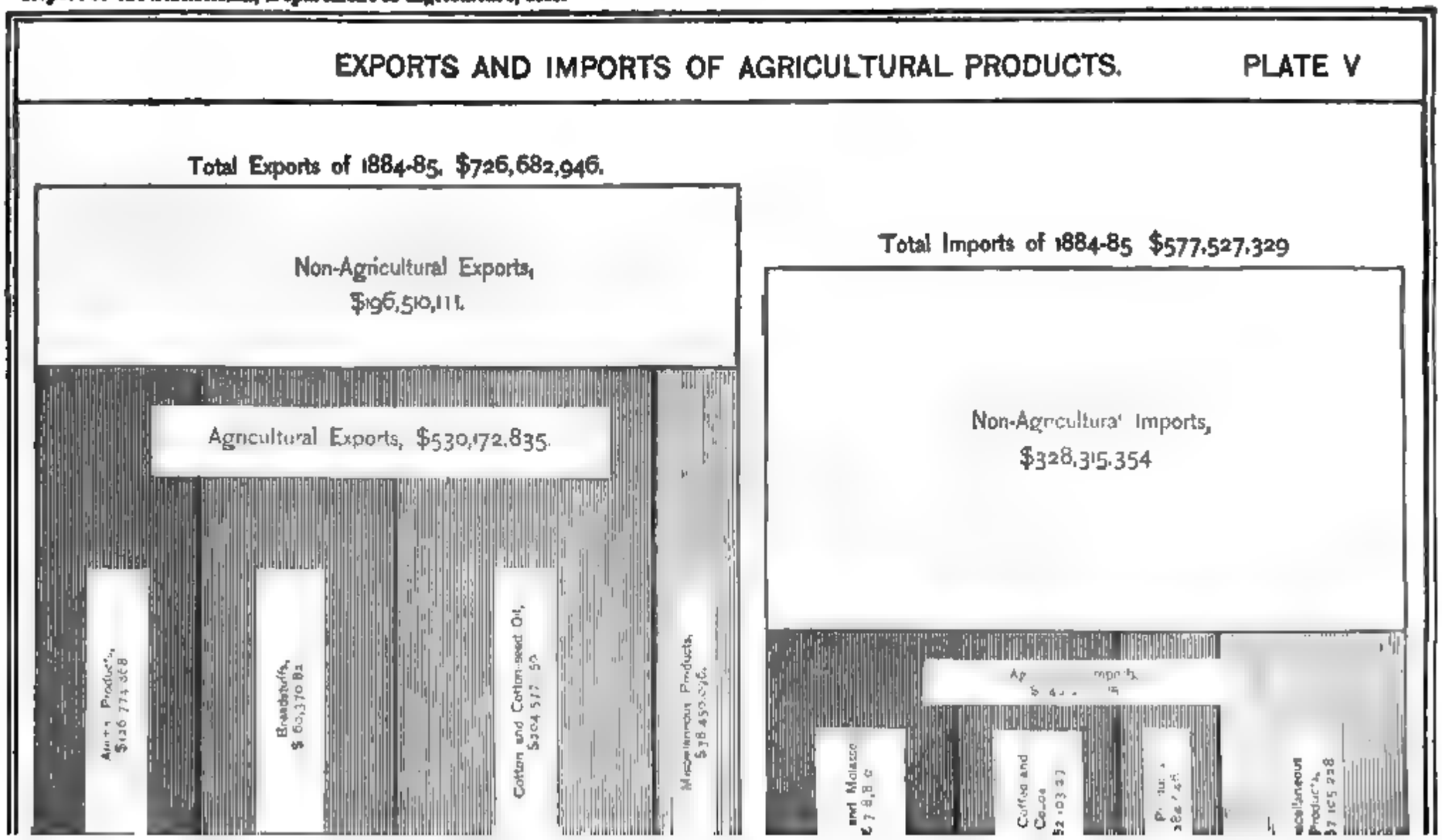
In 1866 an investigation was made to ascertain the prevailing neration of farm labor, whether employed by the year, the sea during the hay or wheat harvest. The payment is reckoned by month for the longer periods and by the day for harvest work. Two usages prevail: payment wholly in cash, the laborer in one e viding his own board and lodging, and in the other receiving a part of his compensation. The difference in the rate repr assumed value of board, and differs according to the cost of l being less in the West than in the East, and still less in the South.

In the South the wages system is less prominent, though every in use. The change from involuntary servitude in a large class of was naturally, and perhaps necessarily, attended with too much tainty, too wide a range of efficiency and value, for the cash plan; hence a system of share contracts was introduced, which prevails to a considerable extent.

It was found, in 1866, that the average for white labor was $28 p month, and $15.50 with board, this wide difference being caused by th high prices prevailing for food products, and especially for other e penses of living. An accepted estimate of thirty years before made per month with board the average cost of farm labor. An advan of 70 per cent. is thus indicated, much the larger part of it betwe 1861 and 1866. But this high rate was not to be fully maintained, currency depreciated in value as prices fell and normal conditions r turned.

In 1869 the rate for labor paid fully in cash was $25.13, a reductio having occurred in the West, some decline in the East, while in th South an advance had resulted from increasing efficiency in labor an rising confidence in its reliability. In 1875 a further decline had o curred; the reduction in six years being from $32.08 to $28.96 in th East, from $28.02 to $26.02 in the Middle States, and from $27.01 t $23.60 in the West. The average rate with board was $12.41, which only $3.09 less than in 1866. The difference was therefore more in th

EXPORTS AND IMPORTS OF AGRICULTURAL PRODUCTS. PLATE V



lowance for board than in the additional cash allowance, and ion, though material, was less than it seemed.

ollowing period of cumulative effect of the depression, culmi- 1879, there was much labor unemployed, an excess of rural n abnormal reduction of wages, from which a gradual recov- ed, which in 1882 had raised the rate nearly to the level of e up to it in the Western States. The following statement sections the cash rates where board is not furnished, showing al decline of inflated values of the speculative period, the ression of the era of panic, and the ultimate recovery in 1882, hanges indicated by the present returns of the 1st of May,

Section.	1885.	1882.	1879.	1875.	1869.	1866.
.....	$25 30	$26 61	$20 21	$28 06	$32 06	$33 30
.....	23 19	22 24	19 69	26 03	28 02	30 07
s	14 27	15 30	13 31	16 23	17 21	16 09
s	22 26	23 63	20 38	23 60	27 01	28 81
.....	38 75	38 25	41 00	44 50	46 38	35 75

ring twenty years past wages were higher in 1866 than at the y other inquiry, except on the Pacific coast and in the South. ne continued to 1879, and amounted to 39 per cent. in the tates, 35 in the Middle States, 30 in the Western States, and Southern States. Wages have been best sustained in Cali- ng now higher than in 1866. Comparing the rates of the ay with those of 1875, the decline is least in the West, being than 6 per cent., 11 in the Middle States, 12 in the South, and Eastern States and California.

WAGES PER MONTH BY THE YEAR.

tement gives the result of the present investigation, in con- th those of five prior inquiries, at intervals from 1866 to 1885:

rritories.	1885.		1882.		1879.		1875.		1869.		1866.	
	Without board.	With board.	Without board.	With board.	Without board.	With board.	Without board.	With board.	Without board.	With board.	Without board.	With board.
.....	$23 09	$16 00	$24 75	$16 15	$18 25	$11 08	$25 40	$15 94	$26 25	$16 60	$27 00	$17 44
e	22 80	15 75	25 22	16 72	19 75	12 30	28 57	18 25	32 66	22 16	32 74	22 48
.....	23 00	16 20	23 37	16 00	19 00	11 50	29 67	19 37	32 40	21 40	32 64	21 00
.....	28 75	17 85	30 66	18 25	25 00	15 33	31 67	20 25	35 95	22 16	36 94	22 36
.....	28 50	17 70	27 75	17 00	23 00	13 25	30 00	19 00	32 25	20 00	34 40	20 50
.....	27 67	17 20	27 00	17 37	23 29	14 23	28 25	18 50	33 00	20 75	34 25	21 54
.....	24 00	16 52	23 63	15 36	20 61	13 19	27 14	17 80	29 28	18 64	29 57	19 33
.....	23 61	14 10	24 25	14 20	20 22	11 53	30 71	16 78	32 11	19 02	32 27	18 98
.....	22 52	14 12	22 88	14 21	19 92	11 46	25 89	16 10	28 68	18 05	29 91	18 84
.....	18 33	12 83	18 20	12 50	17 00	9 50	26 33	11 67	22 00	13 00	24 99	13 25
.....	18 20	11 50	16 34	9 89	14 00	8 95	20 02	11 42	21 55	12 00	20 36	12 76
.....	13 95	9 34	13 96	9 17	11 00	7 66	14 64	9 21	15 28	9 65	14 82	9 86
.....	12 85	8 91	12 86	8 80	11 19	7 66	13 46	8 82	12 76	7 91	13 46	8 15
.....	12 00	8 25	12 10	8 10	10 25	6 66	12 84	8 19	11 54	7 34	12 00	7 86
.....	12 47	8 73	12 86	8 70	10 73	7 38	14 40	8 79	14 70	9 70	15 51	9 67
.....	17 80	11 37	16 64	10 20	13 80	8 73	15 50	10 75	16 10	10 91	18 00	13 13
.....	13 00	9 10	13 15	9 09	13 20	8 30	13 50	9 40	15 19	10 52	13 40	9 80
.....	14 60	10 00	15 10	10 09	13 31	9 28	16 40	11 26	17 11	11 21	16 72	11 58

States and Territories.	1885.		1882.		1879.		1875.		1869.		186[illegible]	
	Without board.	With board.	Without board.	With board.	Without board.	With board.	Without board.	With board.	Without board.	With board.	Without board.	With board.
Louisiana	$16 05	$11 25	$18 20	$12 69	$16 40	$11 27	$16 40	$12 20	$21 87	$12 [illegible]	$20 [illegible]	$13 [illegible]
Texas	18 87	18 72	20 20	14 08	18 27	11 49	19 60	12 87	18 83	13 21	19 [illegible]	13 [illegible]
Arkansas	17 39	13 25	18 50	13 25	17 12	11 31	20 50	13 00	25 25	16 60	24 [illegible]	15 [illegible]
Tennessee	13 88	9 74	13 75	9 49	12 78	8 69	15 20	10 00	16 81	11 00	19 [illegible]	12 [illegible]
West Virginia	19 00	12 40	18 16	12 46	16 98	10 94	20 75	13 10	21 39	13 87	25 [illegible]	16 [illegible]
Kentucky	16 80	11 69	18 20	11 75	15 17	10 00	18 12	12 00	18 84	12 57	20 [illegible]	13 [illegible]
Ohio	23 00	15 50	24 55	16 30	20 72	13 34	24 05	16 33	26 35	16 74	28 [illegible]	18 [illegible]
Michigan	24 00	16 14	25 75	17 27	22 88	14 64	28 22	18 46	31 01	20 03	31 [illegible]	20 [illegible]
Indiana	22 20	15 30	23 14	15 65	20 20	12 76	24 20	16 14	25 42	17 03	27 [illegible]	17 [illegible]
Illinois	23 50	16 60	22 91	17 14	20 61	13 01	25 20	16 87	27 32	17 69	25 [illegible]	17 [illegible]
Wisconsin	25 54	16 76	26 21	17 90	21 97	13 81	25 80	16 45	30 08	18 47	30 [illegible]	19 [illegible]
Minnesota	25 50	16 75	26 30	17 75	24 56	15 62	26 16	16 36	28 61	17 94	31 [illegible]	21 [illegible]
Iowa	25 33	17 00	26 21	17 96	22 09	13 90	24 35	16 11	28 39	17 87	29 [illegible]	19 [illegible]
Missouri	21 35	14 50	22 39	13 95	17 59	11 86	19 40	13 15	24 47	16 38	26 [illegible]	18 [illegible]
Kansas	24 70	16 00	23 85	15 87	20 67	13 28	23 20	14 65	28 96	18 38	31 [illegible]	19 [illegible]
Nebraska	25 00	16 50	24 45	16 20	23 04	14 58	24 00	14 75	33 25	19 18	35 [illegible]	21 [illegible]
California	35 75	25 00	38 25	23 45	41 00	26 27	44 50	28 60	46 38	29 69	45 [illegible]	30 [illegible]
Oregon	34 00	21 25	33 50	24 75	35 45	23 66	38 25	25 87	.....	.....	35 [illegible]	23 [illegible]
Colorado	33 00	21 25	36 50	27 08	35 00	20 00	38 50	21 14	.....	.....	67 [illegible]	43 [illegible]
Utah	30 00	21 00	.....	.....	28 87	20 50	35 50	25 38	.....	.....	44 [illegible]	31 [illegible]
New Mexico	28 75	17 50	.....	.....	22 10	13 80	22 75	14 35	.....	.....	35 [illegible]	22 [illegible]
Dakota	25 55	17 60	.....	.....	28 58	16 67	32 50	20 60	.....	.....	50 [illegible]	32 [illegible]
Washington	38 33	26 25	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

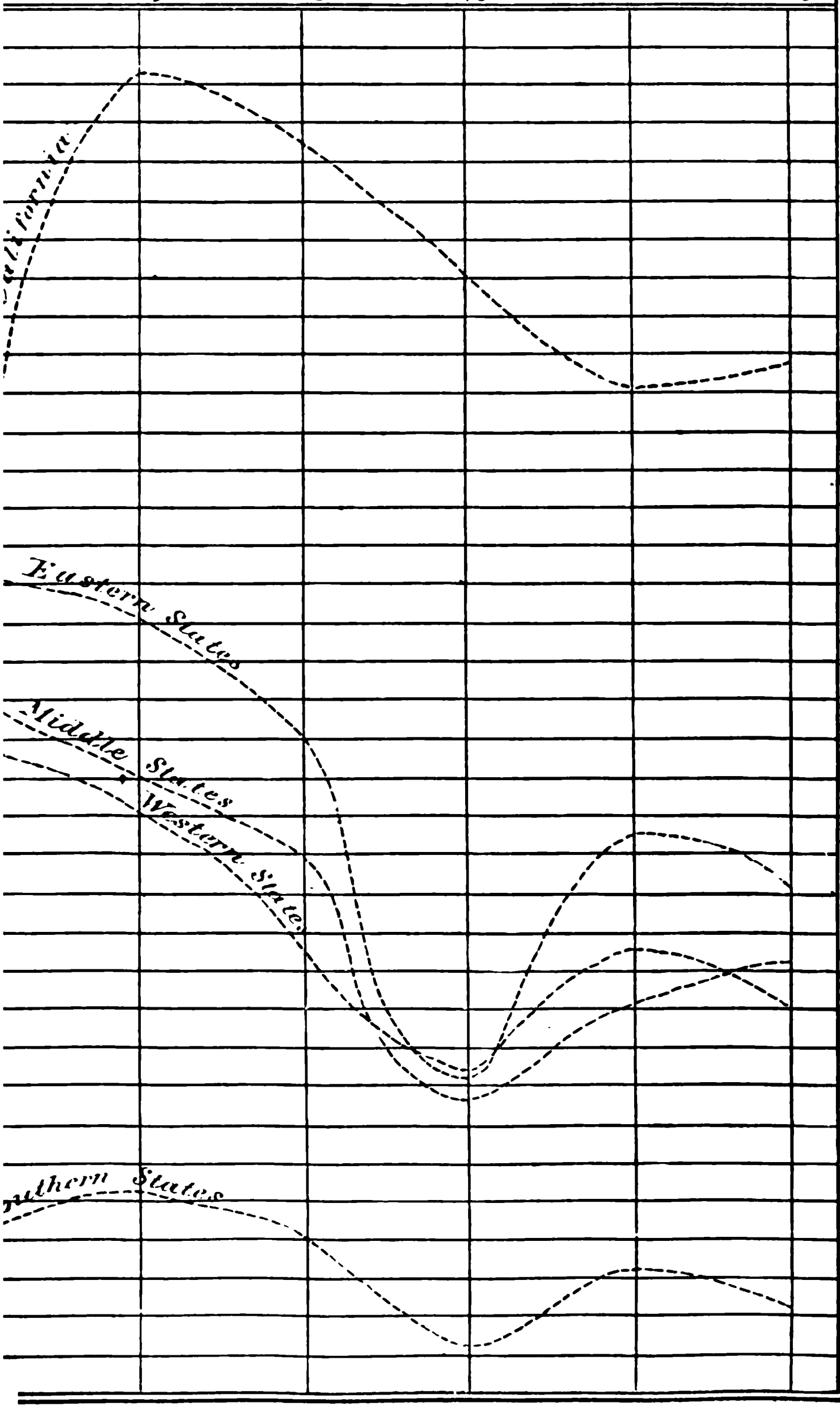
Diagram VI presents, in a striking way, the changes of an eventful period of twenty years, first from the inflated values of the ante-resumption period to the lower wages of the years of commercial and manufacturing depression, and the subsequent rise from 1879. The figure represents a depression at that date which appears as a slough of despond into which all sections fell, surely, if not to equal depths. The eastern or manufacturing section suffered a lower fall, because labor was diverted there from the artisan to the agricultural class, which ultimately suffered nearly as much.

DAY WAGES IN HARVEST.

The following exhibit of average day wages in harvest time, with and without board, corresponds in its periodical changes with those in the statement of monthly wages of labor employed by the year:

States and Territories.	1885.		1882.		1879.		1875.		1869.		186[illegible]	
	In harvest (without board).	In harvest (with board).	In harvest (without board).	In harvest (with board).	In harvest (without board).	In harvest (with board).	In harvest (without board).	In harvest (with board).	In harvest (without board).	In harvest (with board).	In harvest (without board).	In harvest (with board).
Maine	$1 58	$1 19	$1 52	$1 25	$1 42	$1 09	$1 99	$1 49	$2 17	$1 63	$2 [illegible]	$1 [illegible]
New Hampshire	1 65	1 32	1 71	1 35	1 25	95	2 00	1 54	2 37	1 05	1 [illegible]	[illegible]
Vermont	1 68	1 30	1 75	1 35	1 29	97	2 28	1 85	2 46	2 00	2 [illegible]	[illegible]
Massachusetts	1 70	1 31	1 75	1 35	1 50	1 00	1 90	1 50	2 37	1 85	2 [illegible]	[illegible]
Rhode Island	1 60	1 25	1 60	1 30	1 30	95	2 00	1 50	2 37	1 75	2 [illegible]	[illegible]
Connecticut	1 65	1 33	1 65	1 33	1 40	1 25	2 08	1 53	2 40	1 80	2 [illegible]	[illegible]
New York	2 00	1 54	1 89	1 47	1 53	1 18	2 25	1 75	3 53	2 89	3 [illegible]	[illegible]
New Jersey	2 04	1 65	2 09	1 74	1 55	1 30	3 56	2 03	2 63	2 89	3 [illegible]	[illegible]
Pennsylvania	1 65	1 20	1 73	1 30	1 33	99	2 01	1 51	2 23	1 73	2 [illegible]	[illegible]
Delaware	1 48	1 52	1 60	1 25	1 37	1 00	1 83	1 41	1 87	1 [illegible]	2 [illegible]	[illegible]

HANGES OF WAGES OF FARM LABOR. PLATE VI.



erritories.	1885.		1882.		1879.		1875.		1869.		1866.	
	In harvest (without board.)	In harvest (with board.)	In harvest (without board.)	In harvest (with board.)	In harvest (without board.)	In harvest (with board.)	In harvest (without board.)	In harvest (with board.)	In harvest (without board.)	In harvest (with board.)	In harvest (without board.)	In harvest (with board.)
.....	$1 74	$1 38	$1 52	$1 15	$1 43	$1 12	$1 81	$1 34	$2 16	$1 67	$2 00	$1 68
.....	1 33	1 06	1 27	99	1 16	96	1 46	1 21	1 46	1 18	1 46	1 21
.....	1 16	82	1 20	85	99	76	1 17	1 00	1 37	1 04	1 53	1 17
.....	87	64	1 08	78	80	68	1 17	1 01	1 15	90	1 25	93
.....	1 04	80	1 15	86	98	61	1 29	99	1 24	90	1 43	1 06
.....	96	70	1 12	80	1 02	73	1 00	72	1 25	87	1 12	88
.....	99	70	1 05	80	96	77	1 40	1 15	1 24	95	1 27	1 04
.....	1 00	70	1 23	95	1 00	85	1 40	1 00	1 56	1 22	1 65	1 14
.....	95	75	1 10	85	1 03	77	1 30	1 05	1 54	1 13	1 66	1 20
.....	1 32	1 04	1 39	1 08	1 30	94	1 52	1 20	1 56	1 26	1 66	1 32
.....	1 30	1 03	1 34	1 02	1 38	1 06	1 50	1 25	1 67	1 40	2 07	1 32
.....	1 28	1 04	1 30	1 00	1 28	96	1 62	1 20	2 10	1 50	2 01	1 54
.....	1 31	1 03	1 30	1 00	1 26	95	1 55	1 20	1 78	1 29	1 76	1 31
.....	1 51	1 17	1 54	1 18	1 49	1 15	1 79	1 46	1 83	1 38	2 10	1 70
.....	1 75	1 4-	1 79	1 41	1 51	1 17	2 05	1 60	2 15	1 72	2 30	1 73
.....	1 90	1 57	2 13	1 76	2 02	1 55	2 50	2 00	2 76	2 25	2 62	2 14
.....	1 85	1 55	1 80	1 58	1 68	1 28	2 20	1 75	2 16	1 77	2 23	1 76
.....	1 80	1 40	1 91	1 54	1 52	1 18	2 20	1 83	2 34	1 94	2 41	1 61
.....	1 89	1 57	2 50	2 10	2 11	1 70	2 40	1 92	2 45	1 96	2 68	2 15
.....	2 29	1 89	2 61	2 16	2 63	2 25	2 62	2 30	2 90	2 36	2 68	2 37
.....	2 00	1 61	2 25	1 81	1 66	1 67	2 57	2 10	2 85	2 34	2 39	1 66
.....	1 62	1 30	1 59	1 23	1 47	1 17	1 75	1 43	2 30	1 84	2 16	1 72
.....	1 87	1 48	1 70	1 35	1 70	1 32	1 86	1 46	2 06	1 63	2 31	1 82
.....	1 95	1 55	1 95	1 57	2 17	1 66	2 40	1 98	2 41	2 00	2 86	2 15
.....	2 20	1 80	2 70	1 86	2 27	1 76	2 50	2 00	2 69	2 04	2 58	2 06
.....	1 95	1 50	1 92	1 50	2 02	1 54	2 11	1 72	.....	.....	2 40	1 80
.....	2 05	1 50	2 21	1 80	2 08	1 55	2 33	1 50	.....	.....	4 17	2 97
.....	1 75	1 30	2 00	1 56	1 82	1 43	2 20	1 75	.....	.....	2 43	2 49
.....	1 31	88	1 65	1 40	1 00	67	1 85	90	.....	.....	1 50	1 12
.....	2 05	1 50	.....	.....	2 15	1 61	2 40	2 00	.....	.....	3 00	2 25
.....	1 35	1 00	2 65	2 19	.....	.....	2 37	1 90	.....	.....	2 50	2 00

DAY WAGES OF ORDINARY FARM LABOR.

ble gives the wages of transient labor, exclusive of labor in nd commanding lower rates:

g the average rate of wages per day in transient service, other than harvesting.

erritories.	1885.		1882.		1879.		1875.		1869.		1866.	
	Without board.	With board.	Without board.	With board.	Without board.	With board.	Without board.	With board.	Without board.	With board.	Without board.	With board.
.....	$1 19	$ 88	$1 18	$1 01	$0 97	$0 72	$1 46	$1 05	$1 48	$1 05	$1 49	$1 13
.....	1 [illegible]	65	1 10	97	08	74	1 50	1 12	1 79	1 41	1 87	1 26
.....	1 15	88	1 20	90	91	64	1 51	1 11	1 76	1 28	1 76	1 32
.....	1 50	1 08	1 45	1 08	1 05	75	1 44	1 12	1 92	1 37	1 83	1 36
.....	1 15	91	1 28	1 00	1 00	50	1 62	1 18	1 73	1 18	1 83	1 33
.....	1 32	1 00	1 30	98	1 50	88	1 50	1 18	1 87	1 37	1 75	1 29
.....	1 26	95	1 29	93	92	68	1 48	1 06	1 64	1 19	1 75	1 25
.....	1 17	87	1 21	86	90	68	1 45	1 00	1 63	1 15	1 68	1 20
.....	1 13	80	1 20	85	95	63	1 37	96	1 43	1 04	1 50	1 10
.....	1 06	78	1 13	80	75	50	1 04	70	1 30	95	1 31	94
.....	90	62	84	55	75	48	1 06	71	1 20	77	1 31	96
.....	71	49	70	48	63	44	78	51	80	55	82	57
.....	67	47	68	46	58	41	72	51	74	49	72	50
.....	60	45	65	45	53	41	71	55	70	50	68	45
.....	66	47	70	49	58	44	68	60	63	46	68	70
.....	85	60	75	55	76	53	93	70	86	73	1 00	74
.....	73	52	72	51	69	50	75	53	86	61	75	55

Table showing the average rate of wages per day in transient service, &c.—C

States and Territories.	1885.		1882.		1879.		1875.		1869.	
	Without board.	With board.	Without board.	With board.	Without board.	With board.	Without board.	With board.	Without board.	With board.
Mississippi	$0 80	$0 60	$0 75	$0 55	$0 78	$0 55	$1 07	$0 80	$1 10	$0 80
Louisiana	82	64	80	60	85	62	1 00	74	1 44	70
Texas	98	76	93	70	92	66	1 14	84	1 16	84
Arkansas	89	64	88	62	86	60	1 10	80	1 30	1 02
Tennessee	71	52	72	50	69	50	95	80	1 05	64
West Virginia	83	60	82	50	80	55	1 05	75	1 14	70
Kentucky	84	59	87	60	77	58	1 03	72	1 10	72
Ohio	1 11	85	1 19	89	1 00	83	1 35	1 00	1 44	1 05
Michigan	1 28	93	1 30	96	1 16	82	1 55	1 10	1 66	1 17
Indiana	1 08	80	1 08	78	90	60	1 30	96	1 36	1 01
Illinois	1 14	87	1 19	90	1 01	73	1 37	1 01	1 50	1 13
Wisconsin	1 20	95	1 33	99	1 13	79	1 42	1 00	1 56	1 15
Minnesota	1 25	98	1 37	1 02	1 27	94	1 50	1 07	1 64	1 18
Iowa	1 31	97	1 34	99	1 12	80	1 38	1 01	1 52	1 12
Missouri	95	68	1 00	70	67	59	1 07	73	1 44	1 02
Kansas	1 20	87	1 12	80	1 05	72	1 30	90	1 56	1 12
Nebraska	1 35	97	1 21	91	1 29	90	1 43	1 00	1 62	1 20
California	1 57	1 15	1 71	1 29	1 65	1 23	1 84	1 30	2 13	1 50
Oregon	1 30	95	1 33	1 00	1 44	1 08	1 47	1 15	.....	.....
Nevada	.....	.....	.....	.....	.....	1 45	.....	.....	.....	.....
Colorado	1 55	1 10	1 68	1 14	1 83	1 19	1 75	1 16	.....	.....
Utah	1 52	1 14	1 57	1 10	1 46	1 12	1 80	1 40	.....	.....
New Mexico	1 25	81	1 28	1 00	81	56	85	50	.....	.....
Dakota	1 31	1 08	1 50	1 11	1 34	92	1 62	1 08	.....	.....
Washington	1 70	1 17	.....	.....	.....	.....	.....	.....	.....	.....
Wyoming	.....	.....	.....	.....	.....	.....	3 08	2 38	.....	.....

The following Territories report wages by the month and d
are not included in the above comparisons:

Territories.	Per month (by the year).		Per day.		
			Transient (in harvest).		Transien harv
	Without board.	With board.	Without board.	With board.	Without board.
Arizona	.....	.....	$2 50	$1 50	$2 25
Idaho	$38 50	$23 00	2 00	1 50	1 75
Montana	40 00	23 50	2 60	2 00	2 25
Wyoming	38 50	25 00	1 75	1 30	1 65
Indian	23 50	14 50	1 38	1 00	1 13

AGRICULTURAL IMPLEMENTS.

The influence of the agricultural implement industry upon
ure is liable to be underrated. This industry is a great factor
duction, which renders possible the extension of crop areas into s
settled regions, and cheapens the cost of products without des
the profit of production. It enabled the country, with millions o
ers withdrawn from rural labor to fields of warfare, to supply
mestic wants and provide a large surplus for export. In later y

nl: ed production beyond the requirements of home consumption,
l ed labor for the extension of production in the domain of
g, or construction, of fabrication, and differentiation of labor in
e)ment of art, industry, and every form of wealth, without ren-
ing the necessaries of life scarce and dear, or reducing the wages
labor. In fact, the rate of wages for farm labor is not only higher
harvest time, but is highest in those regions where farm machinery
st used. This is an era of too much intelligence to allow the
)f progress to be blocked by prejudice on the part of laborers.
ery)or-saving appliance advances the interest of the intelligent
rer, relieves him of drudgery but not of direction, lightens his
without destroying his vocation, and tends to elevation and par-
tion in the benefits of invention and advancing skill. The prog-
)f manufacture in this country has been very rapid. The number
blishments making agricultural implements of all kinds in 1850
,333; in 1880, 1,943. But this difference does not indicate the
xtent of development in the manufacture. The number of hands
oyed was 7,220 in 1850; in 1880 the average number was nearly
es as many, 40,180. This showing also fails to indicate the true
of progress, for the capital employed was about seventeen times
ch, and the products were ten times as much, having increased
842,611 to $68,620,486, showing that the buildings and ma-
y, the "plant" of the industry, are more substantial and per-
, and also that labor is more effective, producing larger values
r nand, though the prices have meantime been very much reduced.
ential data of this progress may be presented as follows:

Years.	Number of establishments.	Capital.	Hands.	Wages.	Material.	Products.
.....	1,333	$3,564,202	7,220	$2,167,868	$2,445,765	$6,842,611
.....	1,982	11,477,239	14,814	5,070,674	5,625,169	17,487,960
.....	2,076	34,834,600	25,249	12,157,504	21,473,925	52,066,875
.....	1,943	62,109,668	40,180	15,350,610	31,531,170	68,620,486

n recent years the cost of material increases in larger proportion
wages or products. The tendency to advance is constant in
od, while the price of iron and steel tends to decline. Nearly
,000,000 are annually distributed for material and wages, millions
are paid for the use of capital, for constant repairs, replacements,
the substitution of better machinery, and allowed for services of
usands of proprietors not receiving wages for service; for inventors
l draftsmen, and for royalties for inventions, for advertising, for in-
nce, and other incidental expenses; and the remainder, little or
h, but a small part of the whole value, goes to account of profits of
t ness.

R ive to the amount of production, Ohio stands first in this manu-
ure, with products in 1880 valued at $15,479,825; Illinois comes
xt with $13,498,575; New York produces $10,707,766; Indiana,
408; and Wisconsin, Pennsylvania, and Michigan each make a
of over $3,000,000. Ohio, Illinois, and New York come in similar
of k as to capital, with more than half of the total investment
|

used, more than half the value is iron and steel,

$18,083,502; wood, $5,669,516; other materials, $7,778,152. Th tively large proportion of materials to product is due to the red in prices of implements and machines. In this connection it is able to notice the increase in number of implements.

The increase of implements manufactured relates not only t bers but to variety. Machines for harvesting were well advan 1870, yet improvements have been constant and valuable sinc date. The increase of ten years is thus noted:

Implements.	1880.	1870.	Implements.	1880.
Seeders and planters:	*Number.*	*Number.*	Harvesting implements—Continued.	*Number.*
Corn-planters	68,691	21,709	Potato-diggers	33,453
Cotton-planters	19,288	2,000	Reapers	35,327
Fertilizer distributers	8,155	.....	Reapers and mowers combined	54,930
Grain-drills	43,222	32,033	Scythes	1,244,264
Grain-sowers	15,563	.....	Scythe-snaths	437,178
Seed-sowers	20,289	6,900	Sickles	96,618
Transplanters	4,245	.....	Seed separators:	
Implements of cultivation:			Clover-hullers	1,412
Clod-crushers	654	.....	Corn-huskers	44,570
Cotton-choppers	138	.....	Corn-shellers	59,157
Cultivators	318,057	88,740	Fanning-mills	45,412
Harrows	127,997	9,150	Separators	9,168
Hoes	3,592,056	1,631,668	Thrashers	10,424
Plows	1,326,123	864,947	Miscellaneous:	
Shovels	2,545,764	809,072	Cane-mills	2,356
Rollers	8,002	4,803	Cider and wine mills	10,202
Harvesting implements:			Feed steamers and boilers	1,482
Fruit gatherers	315	.....	Hay and straw cutters	33,883
Grain-cradles	167,402	103,646	Hay-presses	791
Harvesters	25,737	3,566	Horse-powers	11,161
Hand-rakes	3,704,784	2,487,720	Stalk-pullers	93
Hay-forks	2,480,724	1,298,256	Stone-gatherers	9,066
Hay-loaders	8,957	.....	Stump-pullers	703
Hay-tedders	2,334	.....	Sirup-evaporators	1,460
Horse-rakes	95,625	80,619		
Lawn-mowers	47,661	2,536		
Mowers	72,090	39,486		

EXPORTATION OF AGRICULTURAL IMPLEMENTS.

The exportation of agricultural implements is a trifle com home consumption, nor does it increase as rapidly as the exte manufacture. The first separate official statement of exports o ments was in 1864, when the value of such exports was $611,1 the following year the record was $1,385,274, possibly 3 per cen production. It was much less in 1867 and 1868, and did not m ceed $1,000,000 again till 1872. In the six years from 1864 to 1 clusive, the value of exports aggregated $6,016,557.

The exports of the last twenty-one years are valued at $42,53 an average of about $2,000,000 per annum. The exportation l sibly been 4 per cent. of the production, after reducing export v factory values. This point should not be misunderstood. As the is heavy, and is brought to the sea-board, a distance of 500 t miles, before exportation; it is cause for national congratulati so large a surplus can be shipped throughout the world. I merely cheapness that renders it possible, but the ingenuity of chinery, the skill in manufacture, and lightness and strength o rial. Our people would scarcely take foreign implements as a g foreign nations are learning their superiority.

The following table shows our total exportation of this class o nets for each fiscal year from 1870 to 1884, inclusive, with the n

nes of some of the more important classes of implements, and l values from 1864 to 1884, inclusive:

TABLE I.

	Fanning-mills.		Horse-powers.		Mowers and reapers.		Plows and cultivators.		All other not elsewhere specified.	Total.
	No.	Value.	No.	Value.	No.	Value.	No.	Value.	Value.	Value.
.....	...	... ..	..	.....	.....	.....	.....	.....	.....	$6, 016, 551
.....	38	$2, 237	21	$4, 316	537	$65, 538	11, 893	$143, 527	$652, 863	1, 068, 476
.....	19	1, 390	26	10, 167	3, 542	354, 263	9, 586	129, 014	566, 112	1, 070, 946
.....	19	470	11	2, 200	6, 084	714 016	17, 895	211, 406	618, 321	1, 547, 413
.....	72	2, 144	61	11, 252	9, 728	1, 243, 033	33, 133	444, 163	884, 422	2, 585, 914
.....	63	2, 645	50	30, 685	16, 139	1, 797, 130	17, 639	286, 203	1, 022, 000	3. 089, 753
.....	110	14, 263	38	17, 271	14, 580	1. 593, 509	9, 805	128, 747	876, 582	2, 625, 372
.....	126	2, 949	117	32, 284	12, 127	1. 225, 935	15, 064	146, 467	848, 794	2, 256, 449
.....	57	10, 654	62	24, 297	7, 578	705 240	14, 939	129, 285	686, 538	1, 815, 873
.....	126	2, 066	65	19, 872	10, 496	1, 018, 910	20, 710	154, 877	1, 379, 467	2, 575, 198
.....	50	8, 042	30	17, 147	9, 412	893. 972	21, 975	160, 822	1, 854, 405	2, 933, 388
.....	4	805	28	11, 682	6, 019	788, 945	21, 254	169, 211	1, 295, 599	2, 246, 742
.....	24	764	13	2, 002	5, 913	654, 156	30, 166	194, 839	1, 548, 566	2, 400, 318
.....	5	127	43	9, 890	10, 512	1, 008, 724	31, 810	290, 177	1, 672, 455	2, 976, 971
.....	140	2, 499	136	36, 651	13, 798	1, 492, 926	39, 627	374, 477	1, 977, 896	3, 883, 919
.....	.	.....	.	28, 622	.....	2, 096, 298	.....	852, 304	065, 543	3, 442, 767
.....	...	50, 455		259, 338	.	15, 688, 505	... ..	3, 259, 478	17, 360, 123	36, 517, 899
.....	...	... .	.	... .	.....	.....	.....	.....	....	42, 534, 450

ollowing table shows the value of our exports of the principal of implements, and the total value of all classes from 1870 to clusive, as well as the total value for the twenty-one years from 1885, designating a number of the countries to which our exports mparatively large:

TABLE II.

Countries.	Exports from 1870 to 1884, inclusive.						[redacted] exports from 1864 to 1884, inclusive.
	Fanning mills.	Horse-powers.	Mowers and reapers.	Plows and cultivators.	All others not elsewhere specified.	Total from 1870 to 1884.	
ia and Ireland .	$1 113	$350	$3, 069, 951	$36, 710	$2, 930, 246	$7, 977, 484	$8, 495, 441
....	146	4, 725	4, 168, 545	15, 055	2. 472, 075	8, 660, 548	6, 725, 093
essions in Austral-							
.....	20	4, 619	1, 046, 008	16, 554	2, 445, 825	3, 513, 026	4, 329, 067
.....	..		2, 439, 453	31, 958	1, 578, 434	4, 049, 843	4, 078, 573
Republic †	1, 673	200	1, 087 221	422. 060	1, 612, 682	3. 125, 032	3, 522, 227
ion of Canada	11, 835	84 [illegible]	[illegible]	[illegible]	[illegible]	2, 069, 281	2, 601, 613
essions in Africa	95	3, 370	4 049	1, 969 799	1, 103 576	2, 277, 769	2, 572, 116
. ...	2 412	90	0 2	[illegible]	740 235	819, 154	1, 813, 815
Porto Rico	755		[illegible]	321 763	393, 029	718, 558	1 446, 006
....	26, 503	152, 893	102, 033	215, 684	488, 481	986, 494	1, 167, 579
....	087	940	191 979	383. 405	301, 087	878, 348	931, 878
ia of Colombia	251	1, 211	2, 486	18, 818	641, 362	664, 079	943, 251
.....	2, 424	3, 306	31, 026	103, 173	407, 386	547, 315	890, 792
l to the countries ve named . ..	4-, 193	256. 79	14 654, 387	3, 136. 700	18, 185, 518	34, 281, 628	39, 649, 050
stries	2, 262	2. 008	1 034 118	122, 778	1, 074, 605	2, 236, 371	2, 885, 400
l to all countries ..	50, 455	259 338	15. 6-8. 505	3, 259, 478	17, 360, 123	36, 517, 899	42, 534, 450

* For 1864 British India was included.
† For 1864 Uruguay is included with the Argentine Republic.

An examination of the figures relative to exports from 1870 to 1884 show that of the total value exported during this period of fifteen y ($36,517,899), fanning-mills and horse-powers together made less t 1 per cent., mowers and reapers about 43 per cent., and plows and tivators about 9 per cent., leaving about 47 per cent. for "all othe plements not elsewhere specified." The following table shows app mately the percentage of each class of implements exported to countries designated in Table II during the period for which the se classes are separately stated, namely, the years from 1870 to 188 clusive:

TABLE III.

Countries.	Fanning-mills and horse-powers.	Mowers and reapers.	Plows and cultivators.	All ot whe fi
Great Britain and Ireland	(*)	62.8	*0.5	
Germany	0.1	62.6	0.2	
British provinces in Australasia	0.1	29.8	0.5	
France	.....	60.2	0.8	
Argentine Republic	0.1	34.8	13.5	
Dominion of Canada	4.6	25.7	20.6	
British possessions in Africa	0.1	1.8	47.0	
Brazil	0.3	0.1	9.2	
Cuba and Porto Rico	0.1	0.4	44.8	
Chili	†18.3	10.4	22.0	
Uruguay	0.2	21.9	43.6	
United States of Colombia	0.2	0.4	2.8	
Mexico	1.0	5.7	18.9	

*Fanning-mills, horse-powers, plows, and cultivators together make a fraction less than 0.5 cent.

†Fanning-mills 2.7 and horse-powers 15.6.

The following table shows for each year from 1864 to 1884, sive, our total exportation of agricultural implements to each c countries designated in Tables II and III, thus exhibiting the tions from year to year in the amounts which they have respec taken:

TABLE IV.—*Total values of agricultural implements exported from* 1864 *to* 1884, *by years, and in part by countries.*

Years.	Great Britain and Ireland.	Germany.	British possessions in Australasia.	France.	Argentine Republic.	Dominion of Canada.	Ex pos A
1864	$28,742	$19,352	$173,218	$9,159	$24,771	$47,104	
1865	158,230	25,975	232,761	7,533	31,618	71,290	
1866	124,696	5,314	209,407	10,236	34,771	92,309	
1867	87,222	.....	93,846	1,803	43,941	98,483	
1868	36,671	8,316	56,515	.....	114,600	97,147	
1869	82,396	10,590	110,294	.....	147,494	126,058	
1870	166,439	29,075	104,064	150	186,913	115,789	
1871	307,225	68,673	57,230	1,737	64,605	109,139	
1872	353,025	344,457	27,691	2,660	103,690	152,128	
1873	458,224	868,793	63,565	6,006	227,107	114,381	
1874	390,594	1,353,215	74,754	158,806	112,899	134,108	
1875	497,607	1,099,625	57,772	200,630	73,983	128,744	
1876	813,604	535,321	59,025	185,843	53,757	61,605	
1877	406,595	283,625	166,696	280,137	78,772	108,467	
1878	663,107	398,129	229,509	641,484	99,137	84,317	
1879	616,225	298,771	664,756	632,817	203,078	120,564	
1880	501,021	301,109	133,393	503,012	105,516	53,822	
1881	682,616	234,812	352,517	301,949	221,052	79,881	
1882	549,250	232,470	319,118	357,711	497,178	203,845	
1883	790,882	283,058	589,018	403,708	658,115	468,572	
88[illegible]	781,010	329,413	614,518	373,192	439,290	138,985	
Total	8,495,441	6,725,093	4,389,667	4,078,573	3,522,227	2,601,612	

E IV.—*Total values of agricultural implements exported, &c.*—Continued.

Brazil.	Cuba and Porto Rico.	Chili.	Uruguay.	United States of Colombia.	Mexico.	Other countries.	All countries.
$29,073	$75,842	$12,956	.....	$41,947	$33,701	$58,270	$611,152
140,852	173,427	28,478	$20,229	105,210	124,868	200,672	1,385,274
477,053	149,427	21,558	9,700	42,220	72,638	97,547	1,373,004
186,891	126,432	16,983	17,897	99,218	89,344	101,244	990,210
51,006	100,840	51,178	11,956	22,397	21,352	56,066	673,381
108,886	102,580	75,922	49,754	28,280	31,574	135,280	1,037,530
148,885	54,491	24,299	33,206	85,742	20,439	88,161	1,068,476
108,078	58,213	46,273	14,859	17,188	32,291	96,446	1,070,945
47,192	71,886	36,219	31,282	80,137	22,948	89,953	1,547,413
55,883	75,727	75,718	62,799	152,369	17,870	102,491	2,585,914
214,090	43,315	146,809	19,310	97,639	25,390	144,583	3,089,753
19,177	41,378	84,306	13,672	52,818	20,843	221,980	2,625,372
9,862	27,048	88,075	32,796	59,550	18,243	163,762	2,256,449
8,450	39,128	59,190	50,998	34,122	21,881	137,670	1,815,873
22,928	30,612	28,393	42,805	41,502	21,285	144,906	2,575,198
22,424	24,040	26,389	48,572	31,086	39,958	97,261	2,933,388
45,087	33,232	37,788	54,847	19,955	30,298	108,574	2,246,742
56,722	50,208	32,253	75,421	16,383	37,659	72,648	2,400,318
27,461	69,163	54,121	92,296	13,361	89,138	274,448	2,970,271
18,159	66,775	97,462	184,908	15,886	97,057	123,847	3,883,919
14,956	33,342	84,195	120,625	6,391	71,648	370,024	3,442,767
1,813,815	1,446,906	1,187,579	981,878	943,351	890,792	2,885,400	42,534,450

following table shows in detail the distribution by countries of orts of agricultural implements during the fiscal year 1884, ex- the total value exported and the values of the different classes ements:

TABLE V.

Countries.	Horse-powers.	Mowers and reapers and parts of.	Plows and cultivators and parts of.	All others and parts of not elsewhere specified.	Total.
Republic	$306	$306,197	$55,211	$77,496	$439,290
.....	.....	106	.....	.....	106
.....	.....	235	24	18,847	19,126
.....	90	96	9,618	5,162	14,956
merican States	.....	.....	679	2,822	3,501
.....	20,036	8,393	26,791	28,975	84,195
.....	.....	.....	6	73	79
.....	.....	4,469	35	9,325	13,810
est Indies	.....	.....	344	348	692
.....	.....	179,783	[redacted]	182,813	373,192
est Indies	.....	.....	.....	3,218	3,218
ossions, all other	.....	.....	.....	93	93
.....	200	203,739	8,722	116,752	329,413
.....	.....	532,997	15,804	123,946	672,747
.....	.....	22,980	5,812	34,956	63,759
.....	300	41,435	344	2,425	44,504
.....	.....	.....	145	.....	145
a, New Brunswick, and Prince Island	.....	418	1,105	2,754	4,277
ario, Manitoba, and Northwest	5,414	879	24,183	82,982	113,458
nbia	.....	711	843	12,897	14,451
d and Labrador	.....	237	498	6,064	6,799
Indies	85	213	1,810	2,847	3,901
duras	.....	.....	.....	62	62
n Indies	.....	.....	709	32	831
ana	.....	.....	.....	15	15
.....	.....	.....	.....	1,220	1,220
sions in Africa and adjacent	.....	9,095	39,825	14,748	64,578
ssions in Australasia	44	481,678	4,462	126,134	614,518
Islands	277	[redacted]	8,940	31,894	41,062
.....	.....	.....	150	316	466
.....	.....	3,255	497	1,232	4,985
.....	.....	.....	.....	794	794
.....	.....	.....	.....	41	41

TABLE V—Continued.

Countries.	Horse-powers.	Mowers and reapers and parts of.	Plows and cultivators and parts of.	All others and parts of not elsewhere specified.	Total.
Mexico	721	12,058	24,985	33,934	7
Netherlands	.....	458	187	2,226	
Peru	.....	231	2,559	4,465	
Portugal	.....	.....	45	286	
Azore, Madeira, and Cape Verde Islands	.....	.....	73	526	
Roumania	.....	113	.....	.....	
Russia on the Baltic and White Seas	188	50,340	247	2,069	
Russia on the Black Sea	.....	134,723	180	20,976	
San Domingo	.....	.....	1,573	346	
Spain	.....	17,445	862	499	1
Cuba	.....	307	22,244	5,074	2
Porto Rico	.....	.....	4,083	1,694	1
Spanish possessions in Africa and adjacent islands	.....	.....	87	.....	
Spanish possessions, all other	.....	.....	.....	5,549	
Sweden and Norway	.....	22,175	.....	2,282	1
Turkey in Europe	250	8,670	.....	.....	
United States of Colombia	621	1,409	1,563	2,796	
Uruguay	.....	54,599	56,659	9,367	
Venezuela	.....	124	277	448	
All other countries and ports in South America not elsewhere specified	.....	.....	78	256	
All other countries and ports in Africa not elsewhere specified	.....	64	.....	.....	
Total	28,622	2,096,298	352,304	965,543	2,46

Over half of this exportation has been taken by the countries of I and South America, Africa, and Australasia. The recent incr exports of reapers has been largely due to the increased demand for improved self-binders. In 1884, according to Mr. A. Blue, secr the bureau of industries of Ontario, three thousand self-bin brought into that province. The number of mowers and r ported in 1884 was double the number for 1882.

THE MONEY VALUE OF SCIENTIFIC AGRICULTURE.

Agriculture involves all physical science. Earth, air, light, h moisture are ever factors in vegetable germination and growth. ural laws direct and control the operations of the husbandman, ever ignorant, and his practice, if wise and judicious, is an uncon formula of the results of science applied to agriculture. Th in every rural community, however primitive and unle methods and traditionary practices, which are crystallized c and unwritten science.

There is a vast distance, however, between the unconscious science of the untaught farmer and the highest application of the latest discoveries of natural laws, and that distance will be greatly extended in the future.

Experiments in vegetable physiology and the increase of production by enlarging the natural supply of mineral constituents are questionings of nature suggested by the latest scientific development, the answers to which may lead the way to higher production at lower cost.

This brings to view the idea of my theme—that there is *money* in experiment, in high culture, in scientific agriculture. As profit is a prime aim in agricultural production, next to the necessity of subsistence, it is

nt to show the superior value of the highest learning and skill practice over the lowest type of primitive cultivation.

Statistical research shows that a crude agriculture is not abundant product, that it is deficient in working capital, and that it is compelled to pay high interest on borrowed money. A low grade of farming is cursed with mortgages and mildews, with insects and ignorance. ainty broods over its harvests, and famine decimates its people. e is unknown in a country of advanced agriculture, though a of its people only may be engaged in rural production. On the , millions famish in India, while most of its people are in agri-. It is said that in 1270, in England, "parents ate their children wheat rose to 336 shillings a quarter at the present value of y." Five hundred years ago, when nearly every Englishman lived iculture, the product only sufficed for a home supply; now, with ulation of 446 to the square mile, of which only one in eight is an ricultural worker, six-tenths of all the food required for consumption duced at home, though half the island is occupied for residences, re-grounds, and hunting preserves.

se eras present wide contrasts, the most remarkable of which are e which suggest advances in agriculture through applied chemis-, physiology, mechanical science, and other developments of modern ing.

Latin races of Southern Europe, slower than the Anglo-Saxon in izing in rural practice the discoveries of modern science, are still king sure progress towards a higher and more profitable agriculture. Italy lands are more productive, buildings more numerous and content, and the peasant is better paid and better lodged and clothed.

official commission has recognized the improvement as a measure ogress in scientific agriculture, and made the future prosperity of pendent upon schools and scientific experiment.

Italian commission has learned the lesson of all time, that primiscientific agriculture is poor, when it declares:

experience of all times and of all places has demonstrated the fact that purely cultural countries are never rich, even from an agricultural standpoint, while in e countries where the arts, industries, and commerce flourish private gain creates wealth.

such countries only can learning and science flourish, for this high rcial and industrial activity is their natural offspring; and only ch countries can the most productive and profitable agriculture

n is mainly agricultural, yet its entire value of rural production ld be purchased with the value of the corn crop of the United States. s because the yield is small and the price low. Russia, with labor loyed principally in agriculture, yields but 19 bushels of cereals head, while Great Britain, with seven-eighths of her people emyed outside of agriculture, last year produced 10 bushels of cereals every inhabitant of the country. In Great Britain the yield per of wheat is 28 bushels; in Russia scarcely more than a third as . This high yield has been attained by science applied to agricult-. A single individual has given his life and his fortune to experiagriculture, and endowed his experimental farm with the income etuity from half a million dollars.

yield of a country is no indication of the natural fertility e richest soils of the world under the rude methods of

primitive agriculture return low ylelds. The progress of skill and ing is indicated by a country's average of yield. The statis mission of the International Congress twelve years ago made the ave yield of wheat 12.6 bushels in Hungary, 13.2 in Portugal, 17.1 in F 24.8 in Holland, and 29.9 in Great Britain.

In this country, where maize is a universal crop, the richest d do not necessarily produce the largest yields per acre. New Eu with a soil of sand and gravel, averaged in the last five harv bushels per acre, with good culture and the use of fertilizers. Im souri Valley, fat with the elements of maize growth, yielded at the of 29.8 bushels, and the Ohio Valley 26 bushels, while the Middle with much aid from experimental science, came very near Western results with 29.4 bushels.

In seasons unfavorable to production, the money value of skill science in agriculture is immensely enhanced. It is often n that farmers receive as much for a very small crop as for a very one. In 1881, 1,195,000,000 bushels of corn were worth in 1884, 1,795,000,000 bushels were valued at $641,000,000; a was worth 63.6 cents per bushel, a larger one 35.7 cen cotton once sold for $40,000,000 less than the previous c more than a million bales larger. Nevertheless, there u small crop. The failure is unequally distributed. The few su farmers grow nearly full crops, and receive larger revenues than the many unskilled and careless suffer disastrous reduction of yi quality, and fail to make return for seed and labor. Given u tific agriculture, with an inauspicious season, and the poor poorer, while the scientific farmer in the same year may grow n

These contrasts in present production and profit of agricultur sufficiently striking. But the present will soon be past. We fronted with a future full of possibilities as of dangers and diffi Experiment, skill, science applied to industry can only avert the Fifteen years ago 47 per cent. of our people were employed in agri ure; five years ago, 44 per cent.; to-day perhaps 42. We find that nations in which more than half of the laborers are in agricultu comparatively poor, and their rural processes are primitive, th plements rude, their rate of production low. We find that in t hu development of agriculture, 20 per cent., or 25 at most, can furn for all. In this country, allowing for surplus production, 40 per c can readily meet the demand of home consumption, and 33 per c will probably do it in the not far distant future, leaving two-thirds produce other forms of wealth. With increase of permanent wea there will come demands for luxuries of living which will add to t profit of the farmer. As the facilities for production increase, c danger from an unscientific, primitive, routine agriculture is great exc in certain crops that have been cultivated from the earliest days w little labor. Already our wheat has encountered the lowest r a century in Great Britain. The present price of wheat in Lo is to-day lower than in the thirteenth to fifteenth centuries.

What is needed, then? Evidently experiment in collecting new p in producing new varieties by scientific process, in cheapening the of cultivation to compete with foreign production by cheap labor. will not do to say that, having learned how to compete with the wo in certain products that are very cheap, we can never learn to c pete in the matter of products that are dear. In our desire for s for large results by labor-saving machinery, we must not fall into in... and declin... investigation, inventive research, and exper

affort. Thought in agriculture must be alert and practical, as in mechanical and constructive industries in this era of mental activity.

Our agriculture is too much controlled by accident and caprice. Free ie lands, improved reapers, and railroad extension make a glut in . The cotton-gin, slavery, and a strong foreign demand once the South poor in buying supplies for man and beast engaged in owing cotton. Thus unequal development reduces profits. While third of the wheat is exported, one-seventh of the consumption of y is imported. We do not grow even the cereals required.

boast of our exports of products of agriculture. We foolishly of feeding the nations of the world. We do not feed ourselves. In 1883 we paid $240,000,000 for food and drink imported, and the freights, commissions, and customs duties in addition; and our food exports, at prices on the farm and in the packing-house, scarcely sufficed to pay the bill of costs of such imports. A large item of this was sugar. Thirty years ago half the sugar used in the United States was pro- in Louisiana. Is it possible that European agriculture can be d with paralysis by American competition, and that this coun- not produce sugar on account of European competition? Less a century ago it cost $1 a pound to produce it there; now 3 cents. we do not expect to manufacture it from sorghum at a cost of 1 per pound, or flood the markets of the world with our surplus of ction in five years, it is fair to assume that the great maize-pro- country of the world will ultimately obtain much of its sugar ghum. The cane regions of Louisiana, Florida, and Texas, by of some process which shall not allow a waste of 40 per cent. of pressed sugar, should aid materially in the home supply for the of consumption. In addition to the cane in the southern belt w sorghum in the great central zone, there is a belt along the rn frontier suited to beet sugar, and there has been no test that s a shadow of doubt of success on the experiment. The Maine iment was a successful manufacture, except that the farmers would y the beets only from garden patches in insufficient quantities for ic manufacture. They lacked land in proper condition, rotation, uzation, and high culture necessary to success; with all these requi- experience in the cultivation of sugar beets would be essential to success. In California a single factory produced 2,000,000 to ,000 pounds of sugar last year, and has made it at a profit for l consecutive years. If one can do it, so also can one thousand. trouble with our farmers, with all their energy and dash, is a dis- ke for new methods, an adherence to routine, and impatience in wait- for results. They will exchange sheep for hogs, or *vice versa*, in a winkling, as prices veer, but will not experiment for the ultimate suc- of new rural industries. As a rule, they cannot well afford to; it ne duty of the Government, the proper business of this Department of the agricultural colleges to do the necessary experimental work which shall usher in new and profitable enterprises in production, which relieve the crowded competition in cereals and cotton, give to the orer a demand for his work, the producer a market for his varied cts, and the country added wealth and foreign exchanges in its r. But the prosperous farmer should cultivate a generous public as well as a laudable *esprit de corps*, and take some risk in intel- experiment that promises beneficent results to his class and e of the public welfare.

s but a glance at this great subject. From these contrasts it rly be assumed that only agriculture which applies the discov-

eries of science will pay at all. If the annual agricultural production of India is worth but $8 for each inhabitant, while that of the United States is worth $64, we may claim some progress in skilled husbandry; but the goal of perfection is still far ahead.

Among the results due to applied science in the work of agriculture the following are prominent:

(1) Fertility is increased; the rate of yield is greatly enlarged; labor is lightened; the laborer is less a "beast of burden" and more a master of machinery. (2) The margin of profit is increased, or rather, one appears where none before existed. (3) Production is equalized—there are fewer gluts of certain products, and greater variety in production. (4) Diasters of primitive agriculture are partially averted—drought deep and thorough culture, excessive rainfall by drainage; insects are less numerous with rotation, and their injuries are outgrown by v of vitality and strength of growth; blights and other maladies of table physiology are avoided by amelioration of the soil and cultiv in harmony with the conditions of healthful growth.

Finally, by application of the discoveries of science, the farmer uni brain with brawn in rural production, labor loses its drudgery; quires effectiveness, the profit and pleasure of agriculture are adv the public wealth and welfare are promoted, and a country life, w ever its previous charms, is far better worth the living.

TRANSPORTATION RATES.

The rates of transportation given are the regularly authorized as reported by the companies. The special rates, the cut discriminations to individuals, whenever and wherever made, are reported and inaccessible. It is a matter of public knowl such modifications of the tariff are sometimes made. Their ex influence cannot be determined with any approach to accuracy.

[In cents per 100 pounds.]

TABLE I.—*Changes in the rates of freight upon grain from Chicago to New York from 1876 to 1885, inclusive.*

Date.	Rate.	Date.	Rate.	Date.	Rate.	Date.	Rate.
1876.		August 17	30	1881.		1883.	
January 1	45	November 25	35			January 1	
March 7	40			January 1	35	April 19	
April 13	35	1879.		February 1	40	November 26	
April 26	22½	January 1	35	March 1	35		
May 5	20	February 1	20	April 1	30	1884.	
December 18	30	March 1	18	April 11	25	January 1	
		April 1	15	April 18	30	January 5	
1877.		May 1	10	June 8	25	January 14	
January 1	30	June 9	15	June 15	15	March 14	
January 2	35	June 22	20	September 26	12½	March 21	
April 2	30	August 4	25	October 10	15	June 24	
September 4	35	August 25	30	November 1	20	July 21	
October 17	40	October 13	35	December 9	12½		
		November 10	40			1885.	
1878.				1882.		January 1	
January 1	40	1880.				April 1	
March 11	30	January 1	40	January 1	12½	July 1	
April 1	25	March 1	35	January 28	20	August 1	
May 17	20	April 14	30	March 25	25	December 1	
August 5	25	November 27	35	December 1	30		

NOTE.—The rates for 1885 are those reported by the trunk lines on the first day of each month.

.—*Rates from Chicago to New York upon certain products, as reported by the several trunk lines upon the first day of each month for the year 1885.*

s.	Cattle.	Horses.	Sheep.	Hogs.	Dressed beef.	Grain.	Flour.	Potatoes.	Tobacco.	Lard.	Pork.	Wool.	Lumber.
.....	40	60	50	30	70	25	25	30	27½	30	30	60	35
.....	40	60	50	30	70	25	25	30	32	30	30	60	35
.....	40	60	50	30	70	25	25	30	32	30	30	60	35
.....	40	60	50	25	70	20	20	25	28	25	25	60	35
.....	40	60	50	25	70	20	20	25	28	25	25	60	35
.....	30	60	40	25	70	20	20	25	28	25	25	60	35
.....	25	60	40	25	48½	15	15	25	28	25	25	60	35
.....	25	60	40	25	48½	20	20	25	28	25	25	60	35
.....	25	60	40	26	48½	20	20	25	28	25	25	60	35
.....	25	60	40	25	48½	20	20	25	28	25	25	60	35
.....	25	60	40	25	48½	20	20	25	28	25	25	60	35
.....	25	60	40	30	48½	25	25	25	28	30	30	60	35

I.—*Lake freight on wheat and corn from Chicago to Buffalo during the season of* 1884 and 1885.

1885.		1884.		Date.	1885.		1884.	
Wheat.	Corn	Wheat.	Corn.		Wheat.	Corn.	Wheat.	Corn.
2¾	2¾	2¾	2	Aug. 22	1½	1½	2	1½
2½	2	2	1½	Aug. 30	2	1½	2½	2
1½	1½	2½	2	Sept. 7	1½	1½	2	1½
1½	1½	2½	1½	Sept. 14	1½	1½	2	1½
1½	1½	1½	1½	Sept. 22	1½	1½	2	1½
1½	1½	2½	2	Sept. 30	1½	1½	2	1½
1½	1½	2½	2½	Oct. 7	2	1½	2	1½
1½	1½	2½	2	Oct. 14	2½	2	2	1½
2	2	2	1½	Oct. 22	2½	2	2	1½
1½	1½	2	1½	Oct. 31	2	1½	2	1½
1½	1	2	1½	Nov 7	2	1½	2	1½
1½	1½	2	1½	Nov 14	2	1½	2	1½
2	1½	1½	1½	Nov 22	2	2	2	1½
1½	1½	1½	1½	Nov 29	3½	3½	2½	2

	May	June.	July.	August.	September.	October.	November.
1884.							
.....	2.2	2.2	2.0	1.9	2.1	2.0	2.3
.....	2.3	2.0	1.7	1.6	1.9	1.6	2.1
[illegible]							
.....	2.1	1.4	1.5	1.9	1.7	2.3	2.0
.....	1.6	1.3	1.3	1.6	1.4	2.2	2.0

TABLE IV.—*Canal freight on wheat and corn from Buffalo to New York during the n of 1884 and 1885.*

Date.	1885.		1884.		Date.	1885.		1884.	
	Wheat.	Corn.	Wheat.	Corn.		Wheat.	Corn.	Wheat.	C
May 7	.....	.....	4	3⅜	Aug. 23	4	3⅝	4⅛	
May 10	.....	.....	3⅜	3¼	Aug. 30	4¼	3⅜	4⅜	
May 17	4⅛	4	3⅛	3¼	Sept. 6	4	3⅝	5	
May 24	3⅜	3⅜	3⅜	3¼	Sept. 13	3¼	3⅝	4⅛	
May 31	3¼	3	3⅝	3¼	Sept. 20	3⅜	3¼	4⅛	
June 7	3¼	3	3⅛	3⅛	Sept. 27	3⅜	3⅝	4⅛	
June 14	3⅜	3⅛	3⅜	3⅛	Oct. 4	3⅜	3⅜	4⅛	
June 21	3	2⅞	3¼	3	Oct. 11	3⅜	3¼	4⅛	
June 28	8	2⅞	3¼	3	Oct. 18	4	3⅝	5	
July 5	3	2⅞	3⅝	3¼	Oct. 25	5	4⅝	5⅛	
July 12	3	2⅞	3⅛	3¼	Nov. 1	5¼	5⅛	5⅛	
July 19	3¼	3	3⅛	3⅛	Nov. 8	6	5⅛	4⅜	
July 26	3⅛	2⅞	3⅜	3⅛	Nov. 15	4⅛	4⅜	4	
Aug. 2	3⅛	2⅞	3⅜	3⅜	Nov. 22	4⅛	4	4⅛	....
Aug. 9	3⅛	3¼	4	3⅝	Nov. 24	4⅜	4¼	5⅛	....
Aug. 16	3⅜	3¼	4⅛	3⅝					

	May.	June.	July.	August.	September.	October.	No b
1884.							
Wheat	3.8	3.4	3.6	4.2	4.7	5.0	
Corn	3.4	3.1	3.2	3.8	4.2	4.4	
1885.							
Wheat	4.3	3.2	3.0	3.7	3.5	4.1	
Corn	3.8	3.0	2.8	3.4	3.3	3.7	

TABLE V.—*Average cost per bushel for transporting wheat from New York to Liverp steamer during the twenty years from 1866 to 1885, inclusive.*

Years.	Steamer rates.		Sailing-vessel rates.		Years.	Steamer rates.		Sailing-v rate
	Pence.	Cents.	Pence.	Cents.		Pence.	Cents.	Pence.
1866	4.74	9.48	.....	.....	1876	8.02	16.04	7.64
1867	5.18	10.36	.....	.....	1877	6.93	13.86	6.76
1868	7.18	14.36	.....	.....	1878	7.61	15.22	7.09
1869	6.40	12.98	.....	.....	1879	6.20	12.40	5.90
1870	5.78	11.56	.....	.....	1880	5.88	11.76	5.10
1871	8.16	16.32	.....	.....	1881	4.08	8.16	4.75
1872	7.64	15.28	.....	.....	1882	3.87	7.76	.....
1873	10.56	21.12	9.91	19.82	1883	4.54	9.08	6.25
1874	9.08	18.16	7.83	15.66	1884	3.40	6.80	5.00
1875	8.07	16.14	7.12	14.24	1885	3.60	7.20	.....

The following are the prices paid for carrying grain from New to Liverpool during the years 1884 and 1885:

Months.	1885.		1884.		Months.	1885.		188
	Pence.	Cents.	Pence.	Cents.		Pence.	Cents.	Pence.
anuary	5.00	10	2.35	4.70	July	2.75	5½	4.71
February	4.50	9	2.24	4.48	August	3.00	6	4.68
March	3.00	6	1.56	3.12	September	3.50	7	3.00
April	4.00	8	1.77	3.54	October	4.00	8	4.00
day	3.50	7	1.25	2.50	November	4.00	8	5.79
June	3.00	6	3.08	6.16	December	3.00	6	6.57

Articles.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
Wheat.....per bush..	$0 10	$0 09	$0 06	$0 08	$0 07	$0 06	$0 05½	$0 06	$0 07	$0 08	$0 08	$0 06
Corn.....do....	10	09	06	08	07	06	05½	06	07	08	08	06
Flour.....per bbl..	72	48	48	48	48	36	36	48	36	48	60	36
Flour (sacks).....per 2,240 lbs..	4 80	3 60	3 60	3 60	3 10	3 00	3 00	3 60	3 00	3 60	3 60	3 00
Bacon.....do....	7 20	5 40	3 60	4 20	4 80	3 60	3 60	3 60	4 20	4 80	7 20	6 00
Lard.....do....	7 20	5 40	3 60	4 20	4 80	3 60	3 60	3 60	4 20	4 80	7 20	6 00
Cheese.....do....	7 20	6 00	4 80	5 40	6 00	6 00	7 20	7 20	7 20	7 20	9 00	7 20
Tallow.....do....	7 20	4 80	3 60	4 20	4 80	3 60	3 60	3 60	4 20	4 20	6 60	4 80
Beef.....per tierce..	1 44	96	60	84	84	72	60	72	72	84	1 32	1 08
Pork.....per bbl..	96	66	48	60	60	48	48	54	48	60	96	72
Oil-cake.....per 2,240 lbs..	4 50	3 60	3 30	3 00	3 60	2 70	2 40	3 00	2 40	3 00	3 60	2 04
Cotton.....per lb..	7/16	9/32	1/4 – 5/16	1/4	1/4	9/32	1/4	1/4	5/16	3/8	3/8	5/16
Hops.....do....	1/8	1/8	3/4	3/4	3/4	3/4	3/4	3/4	3/4	1/8	1/8	3/4
Tobacco.....per hhd..	7 20	5 40	5 40	5 40	5 40	4 80	4 80	4 80	4 20	4 80	6 00	4 80
Lard, in small packages.....per 2,240 lbs..	7 20	6 00	4 80	5 40	6 00	6 00	6 00	6 00	6 00	6 00	8 40	7 20
Tobacco, in cases.....per 40 cu. ft..	5 40	4 80	4 80	4 80	4 80	4 80	4 20	4 20	4 80	4 80	4 80	4 80
Apples.....per bbl..	84	60	60	60	60	60	60	72	72	72	72	60
Hams.....per 2,240 lbs..	.....	.....	3 60 – 4 80	4 20	4 80	4 20	3 60	3 60	4 20	4 80	7 20	6 00
Butter.....do....	.....	.....	3 60	6 00	7 20	7 20	7 20	7 20	7 20	7 20	9 00	7 20
Measurement per ton.....40 cu. ft..	4 80 – 6 00	3 60 – 6 00	4 80	4 80	4 20 – 6 00	3 60 – 6 00	3 60 – 4 80	4 80	3 60 – 4 80	3 60 – 4 80	4 80	3 60 – 4 80
Primage.....per cent..	5	5	5	5	5	5	5	5	5	5	5	5

GENERAL TRANSATLANTIC COMPANY—NEW YORK TO HAVRE.

Wheat.....per bush..	$0 16	$0 18	$0 10	$0 10 – 13	$0 08	$0 08	$0 08	$0 07½	$0 06	$0 07	$0 06½ – 07	$0 06
Corn.....do....	15	18	09	10 – 11	08 – 10	10	10	08	08	08	07	07
Flour.....per bbl..	80	1 00	1 00	1 00	80 – 90	90	1 00	90	90 – 1 00	90 – 1 00	1 00	80
Flour (sacks).....per 100 lbs..	27½	25	22½	22	20	20	20	20	20 – 22½	22½	20 – 22½	20
Lard.....do....	27½	25	20	20	17½ – 20	20	20	17½ – 20	15 – 20	17½ – 20	20 – 22½	20

TABLE VI.—*Transatlantic transportation rates*—Continued.

GENERAL TRANSATLANTIC COMPANY—NEW YORK TO HAVRE—Continued.

Articles.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
Cheese ..... do...	$0 50	$0 40	$0 40	$0 40	$0 40	$0 40	$0 40	$0 40	$0 35 40	40	40	35
Tallow ..... do....	27½	25	22½	20	20	20	20	20	17½ 20	22½	20 22½	20
Beef ..... per tierce..	1 50	1 25	1 25	1 25	1 10	1 25	1 15	1 25	90 1 00	1 25	1 25	1 25
Pork ..... per bbl..	1 25	1 09	1 00	1 00	1 00	1 00	1 00	1 00	80 90	1 00	1 00	1 00
Oil-cake ..... per 100 lbs..	30	.....	.....	.....	.....	30	25	30	25 30	.....	30	.....
Cotton ..... per lb..	⅜	⅜	⅜	5/16 ⅜	5/16	5/16	⅜	5/16 5/16 5/16	5/16 5/16 ½	⅜ 7/16	⅜ 7/16	⅜
Hops ..... do....	01	01	01	01	01	01	01	01	01	01	01	01
Tobacco ..... per hhd..	7 00 7 50	7 00 8 00	7 00	6 50 8 00	7 00	7 00 8 00	7 00	6 50 7 00	6 00	6 00 7 00	6 50 7 50	6 00 8 00
Lard, in small packages ..... per 100 lbs..	32½	30 1 00	25	25	25	25	25	27½	22½ 45	27½ 30 32½ 35	25 35	25 35
Tobacco, in cases ..... per 40 cu. ft..	7 00	7 00	7 00	7 00	7 00	7 00	7 00 8 00	7 00	7 00 8 00	7 00	7 00	7 00
Apples ..... per bbl..	80	80	75	75 80	75 80	70 80	80	75	75 85	60 70	90 1 00	75
Hams ..... per 100 lbs..	.....	.....	30	32½	30	30	30	40	30 40	40	40	40
Butter ..... do....	.....	.....	40	40 50	40	40	50	40	30 40	40 50	40	40
Measurement per ton ..... 40 cu. ft..	7 00 8 00	7 00	7 00	6 50 10 00	7 00 10 00	7 00 8 00	7 00 8 00	6 50 8 00	7 00 8 00	6 50 8 00	6 50 8 00	6 00 8 00
Primage ..... per cent..	5	5	5	5	5	5	5	5	5	5	5	5

MONARCH LINE—NEW YORK TO LONDON.

Wheat ..... per bush..	$0 11	$0 08	$0 07½	$0 08½	$0 09	$0 07	$0 01½	$0 05	$0 07	$0 09½	$0 06½	$0 07
								05	07	09½	06½	07
												42

Oil-cake ..... per 2,240 lbs..	4 80	3 60	3 00	3 60	4 20	3 60	1 80 / 2 10	2 40	3 00	3 60	2 70	2 70
Hops ..... per lb..	01	01	01¼	01	.....	¾	¾	¾	¾	¾	¾	¾
Tobacco ..... per hhd..	7 20	6 00	4 50	4 80	4 80	4 80 / 5 40	4 80	4 80	4 80	5 10	4 80	4 80
Lard, in small packages ..... per 2,240 lbs..	9 60	7 20	6 00	6 00	7 20	7 20	6 00	6 00	6 00	6 60	6 60	6 60
Tobacco, in cases ..... per 40 cu. ft..	5 40	4 20	3 60	4 80	4 80	4 20	3 60	3 00	3 60	4 20	4 20	3 60
Apples ..... per bbl..	72	72	72	72	.....	.....	.....	.....	72	72	72	72
Hams ..... per 2,240 lbs..	.....	.....	4 80	4 80	6 00	7 20	4 20	4 20	4 80	5 40	5 40	4 80
Butter ..... do....	.....	.....	6 00	6 00	7 20	4 20 / 4 80	6 00	6 00	6 00	6 60	6 60	6 60
Measurement per ton ..... 40 cu. ft..	5 40	3 60 / 4 20	3 60	4 80	4 20 / 4 80	5 40	3 60	3 00	3 60	4 20	4 20	3 60
Primage ..... per cent..	5	5	5	5	5	5	5	5	5	5	5	5

ANCHOR LINE—NEW YORK TO GLASGOW.

Wheat ..... per bush..	$0 12	$0 08	$0 07	$0 09	$0 60	.....	$0 06½	$0 05	$0 06	$0 09½	$0 09	$0 09
Corn ..... do....	12	08	07	09	60	.....	06½	05	06	09½	09	09
Flour ..... per bbl..	54	42	42	42	48	.....	36	36	36	42	42	42
Flour (sacks) ..... per 2,240 lbs..	4 80	3 60	3 60	3 90	4 20	.....	2 70	3 00	2 40	3 60	3 60	3 60
Bacon ..... do....	7 20	5 40	4 80	5 40	6 00	.....	4 80	4 80	4 80	6 00	8 40	7 20
Lard ..... do....	6 00	4 80	4 80	4 80	5 40	.....	4 20	4 80	4 20	4 80	7 20	6 00
Cheese ..... do....	9 60	8 40	7 20	7 20	8 40	.....	7 20	7 20	7 20	8 40	9 60	8 40
Tallow ..... do....	6 00	4 20	4 20	4 80	4 80	.....	3 60	3 60	3 60	4 80	6 00	4 80
Beef ..... per tierce..	1 44	1 62	96	96	1 68	.....	90	90	78	1 02	1 44	1 20
Pork ..... per bbl..	1 02	72	66	66	90	.....	66	66	54	78	1 08	90
Oil-cake ..... per 2,240 lbs..	4 80	3 60	3 20	3 60	4 20	.....	2 40	2 70	2 40	3 30	3 60	3 60
Hops ..... per lb..	¾	01	01	01	01	.....	¾	¾	¾	01	01	01
Tobacco ..... per hhd..	6 00	4 80	4 80	5 40	4 80	.....	4 80	4 20	4 20	4 80	6 00	4 80
Lard, in small packages ..... per 2,240 lbs..	9 60	7 20	7 20	6 60	7 20	.....	6 00	6 00	5 40	8 40	8 40	7 20
Tobacco, in cases ..... per 40 cu. ft..	5 40	4 80	4 80	4 80	4 80	.....	4 20	4 80	4 80	4 20	4 80	4 80
Apples ..... per bbl..	96	72	72	72	72	.....	.....	.....	84	84	84	72
Hams ..... per 2,240 lbs..	.....	.....	4 80	5 40	6 00	.....	4 80	4 80	4 80	6 00	8 40	7 20
Butter ..... do....	.....	.....	7 20	7 20	8 40	.....	7 20	7 20	7 20	8 40	9 60	8 40
Measurement per ton ..... 40 cu. ft..	4 80	4 80	4 20 / 4 80	4 20	4 20	.....	4 20	4 20	4 20	4 20	4 80	4 80
Primage ..... per cent..	5	5	5	5	5	.....	5	5	5	5	5	5

TABLE VI.—*Transatlantic transportation rates*—Continued.

NORTH GERMAN LLOYD STEAMSHIP COMPANY—NEW YORK TO BREMEN.

Articles.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
Wheat ..... per 100 lbs..	$0 22	$0 21	$0 20	$0 18	$0 17	$0 15	$0 12	$0 12	$0 14	$0 13	$0 13	$0 13
Corn ..... do....	22	21	20	18	17	15	12	12	14	13	13	13
Flour ..... per bbl..	72	72	72	72	70	70	70	70	70	70	70	70
Flour (sacks) ..... per 100 lbs..	24	25	24	22½	20	18	18	20	20	20	20	20
Bacon ..... do....	30	30	28	24	20	17	18	18	18	18	18	20
Lard ..... do....	30	30	28	24	20	18	18	18	18	18	22	24
Cheese ..... do....	42	42	36	36	30	30	25	18	30	25	25	36
Tallow ..... do....	30	30	28	24	20	17	18	18	18	18	18	24
Beef ..... per tierce..	1 50	1 30	1 30	1 00	1 20	1 00	1 00	1 00	1 15	1 25	1 25	1 25
Pork ..... per bbl..	1 00	1 00	1 00	85	75	70	70	70	70	72	72	72
Oil-cake ..... per 100 lbs..	22	22	24	22½	20	18	17	18	18	18	18	18
Cotton ..... per lb..	*¼	*7/16	*½	*½	*½	*½	*½	*½	*½	*7/16	*7/16	*7/16
Hops ..... do....	*¼	*½	*½	*½	*½	*½	*½	*½	*½	*½	*½	*½
Tobacco ..... per hhd..	6 50	6 25	6 00	6 00	6 00	6 00	6 00	6 00	6 00	6 00	6 00	6 00
Lard, in small packages ..... per 100 lbs..	36	36	33	30	30	25	24	25	25	30	25	30
Tobacco, in cases ..... per 40 cu. ft..	3 00	3 15	3 25	3 25	†1 68	1 68	†1 68	†1 68	†1 68	†1 68	†1 68	†1 68
Apples ..... per bbl..	72	72	70	70	70	70	70	65	72	72	72	1 00
Hams ..... per 100 lbs..	.....	.....	30	25	24	20	24	20	25	20	20	24
Butter ..... do....	.....	.....	60	60	60	60	60	60	60	60	60	60
Measurement per ton ..... 40 cu. ft..	5 00 / 10 00	5 00 / 10 00	5 00 / 10 00	5 00 / 6 00	5 00 / 10 00	4 80 / 10 00	4 80 / 10 00	4 80 / 10 00	4 50 / 8 00	4 80 / 10 00	5 00 / 10 00	5 00 / 10 00

*Add 5 per cent. primage.

†Per case.

I.—*Quantity and value of property cleared from Buffalo to tide-water and intermediate points for the year* 1885.

rticles.	Property cleared, through.		Property cleared, way.		Property cleared, through and way.	
	Quantity.	Value.	Quantity.	Value.	Total quantity.	Total value.
scantling feet..	41,693,434	$1,000,642	12,572,349	$301,736	54,265,783	$1,302,378
.... 1,000 feet .	704½	2,465	8,327½	29,145	9,031½	31,610
..... pounds.	9,193,000	45,970	24,176,500	120,880	33,369,500	166,850
.....bushels..	16,243,857	16,243,857	1,759,901	1,759,901	18,003,758	18,003,758
.....do....	204,363	143,054	24,379	17,065	228,742	160,119
.....do....	10,883,495	4,897,573	1,848,116	831,652	12,731,611	5,729,225
.....do....	49,574	39,659	88,616	70,893	138,190	110,552
.....do....	185,334	157,534	19,001	16,151	204,335	173,685
.....do	327,174	114,511	23,413	8,195	350,587	122,706
..... pounds..	84,060,948	2,102,024	.....	.....	84,060,948	2,102,024
d cake do ..	628,000	12,560	.....	.....	628,000	12,560
.....bushels..	8,024	12,036	.....	.....	8,024	12,036

TABLE VIII.—*Gross and net earnings of prominent lines of railroad.*

PENNSYLVANIA RAILROAD.

ars.	Earnings from freight.	Per cent. of gross earnings.	Earnings from passengers.	Per cent. of gross earnings.	Net earnings.	Per cent. of gross earnings.	Gross earnings.
.....	$2,805,306	65.7	$1,251,857	29.3	$1,629,277	42.8	$4,270,670
.....	4,191,784	70.7	1,456,993	24.5	2,296,402	38.7	5,932,701
.....	11,193,565	64.1	5,453,047	31.2	4,189,111	24.0	17,450,169
.....	12,793,160	73.0	3,757,942	21 4	6,271,622	35.8	17,531,707
.....	15,651,741	76.4	3,772,306	18.4	8,699,199	42.4	20,493,253
.....	20,234,046	77.9	4,437,146	17.1	11,330,172	45.9	25,987,659
.....	22,400,120	81.0	5,023,385	18.2	12,178,540	44.1	27,647,009
.....	23,517,176	76.3	5,962,456	19.3	12,956,155	42.0	30,836,982
.....	24,536,789	76.6	6,115,423	19.1	13,696,309	43.8	32,017,813
.....	22,823,329	75.6	6,017,752	19.9	13,621,778	41.8	30,190,885

NEW YORK, LAKE ERIE AND WESTERN RAILROAD.

.....	$8,653,002	66.8	$1,698,470	30.9	$2,823,249	51.4	$5,488,998
.....	3,884,343	75.0	1,180,957	22.8	1,903,336	36.7	5,180,322
.....	10,726,264	70.1	4,450,209	29.1	4,483,385	29.3	15,300,575
.....	11,983,547	74.1	3,968,809	24.5	4,106,450	25.4	16,179,461
.....	13,287,399	72.8	3,461,304	20.5	4,197,727	24.9	16,876,856
.....	14,391,115	77 0	3,682,951	19.7	7,049,183	37.7	18,693,108
.....	15,979,577	77.1	4,041,267	19.5	7,459,375	36.0	20,715,606
.....	14,642,128	73.3	4,384,510	21.9	6,887,680	34.5	19,975,774
.....	15,562,241	75.5	4,134,971	20.1	7,019,672	34.1	20,598,571
.....	12,903,157	73.2	3,676,057	20.9	5,549,639	31.5	17,618,976

NEW YORK CENTRAL AND HUDSON RIVER RAILROAD.

.....	$3,755,320	42.8	$4,456,199	58.1	$3,775,620	45.0	$8,385,217
.....	4,941,678	54.9	3,714,204	41.2	3,456,526	38.4	9,004,366
.....	11,000,958	59.7	6,621,406	35.9	3,629,382	20.0	18,427,004
.....	14,327,418	64.1	6,738,592	30.1	8,295,246	37 1	22,363,320
.....	17,899,702	67 3	7,270,848	27 4	9,323,307	35.1	26,585,415
.....	22,109,966	73.2	6,611,160	21.8	12,469,052	41.1	30,318,946
.....	20,736,750	70.7	6,958,038	23.7	9,857,746	33.6	29,322,532
.....	17,672,252	64 9	7,816,519	28.7	7,853,823	28.8	27,249,797
.....	20,142,423	66.3	8,526,843	28.1	9,613,397	31.7	30,363,991
.....	16,434,983	64.0	7,533,213	29.3	7,827,108	30.4	25,676,431

TABLE IX.—*The Northwestern roads.*

GROSS EARNINGS FROM FREIGHT.

Years.	Chicago and Alton.	Chicago, Burlington and Quincy.	Chicago, Milwaukee and Saint Paul.	Chicago and Northwestern.	Chicago and Rock Island.	Illinois Central.	Aggregate of all.
1870	$3,372,068	$4,514,629	$5,116,141	$8,187,597	$3,587,002	$5 [illegible]	$29,01
1875	8,173,531	8,502,617	5,690,508	9,549,430	5,292,412	5	[illegible]
1880	5,808,484	16,054,209	8,884,226	12,897,777	8,085,168	5, [illegible]	[illegible]
1881	5,546,870	16,595,819	11,884,796	14,414,151	8,690,480	5,875, [illegible]	[illegible]
1882	5,948,128	15,711,509	14,002,335	17,525,184	9,687,097	5,918,152	6
1883	6,197,681	19,514,161	16,365,354	16,894,352	7,928,237	8,664,959	7
1884	6,073,675	18,514,432	16,128,964	17,677,866	8,056,316	7,902,043	7 [illegible]

TONS OF FREIGHT CARRIED.

1870	1,261,432	1,052,754	1,522,753	2,222,978	856,668	1,623,994	8,54
1875	1,545,842	2,396,933	1,832,527	3,153,315	1,717,727	2,016,424	12,66
1880	3,071,788	6,639,186	3,260,353	5,574,635	2,966,763	2,702,582	24,21
1881	3,275,004	7,710,750	4,276,088	6,662,112	3,276,260	2,875,833	28,07
1882	3,522,840	6,346,259	5,127,767	8,190,803	3,754,531	2,909,578	29,85
1883	3,488,496	7,645,701	5,661,607	7,874,665	3,454,868	3,538,562	[illegible]
1884	3,598,284	7,525,997	6,023,016	8,453,994	3,618,142	3,354,085	

NUMBER OF TONS CARRIED ONE MILE.

Years.	Chicago and Alton.	Chicago, Burlington and Quincy.	Chicago, Milwaukee and Saint Paul.	Chicago and Northwestern.
1870	145,000,000	147,409,207	181,428,578	36 [illegible]
1875	168,923,879	436,863,161	272,539,502	45
1880	481,474,730	1,624,461,793	504,876,154	86
1881	417,009,997	1,211,903,074	607,347,607	[illegible]
1882	474,823,008	1,222,808,402	945,250,159	1,
1883	549,369,534	1,552,141,453	1,176,605,032	1
1884	602,768,054	1,427,280,632	1,247,787,239	1

Years.	Chicago and Rock Island.	Illinois Central.	Aggregate of all.	Rate per ton per mile.
1870	130,683,871	265,409,400	1,234,678,291	$1
1875	287,913,578	284,650,900	1,904,997,377	[illegible]
1880	686,458,954	381,288,482	4,544,469,655	01.2
1881	712,383,120	380,035,424	4,435,202,005	01.0
1882	788,466,874	417,702,652	5,041,330,034	01.2
1883	701,595,385	604,632,667	5,768,173,429	01.2
1884	734,601,380	577,542,939	5,940,110,011	01.2

CEREAL SUPPLY OF EUROPE.

The production of cereals of the countries of Europe was given in No 3 of the present series of statistical reports, but the record of th products grown does not indicate accurately the actual supply. Th imports must be added to home production, and exports subtracted fro the sum. Nor will a single year suffice, as both production and com mercial exchanges of grain fluctuate, and the real consumption is no exactly coincident in point of time with the recorded crop movement o each year. But the figures of a period, five or ten years, taken together will afford an average that will represent as closely as is possible o desirable the real rate of consumption.

It has been difficult to collect official data for a consecutive series o

ıd impossible to make the series uniform. Twenty years ago ;w fragments of similar data could be had; even now there are in Europe that do not attempt annual estimates of production. wing statement is a summary of the actual supply of each ed, for food of man, feed of animals, and seed for sowing:

showing the average supply for a series of years of home-grown and foreign and of all cereals, with the average supply per head of population, in centals.

tries.	Population.	Period.	AVERAGE SUPPLY.			
			Wheat.		All cereals.	
			Aggregate.	Per head.	Aggregate.	Per head.
			Pounds.	*Centals.*	*Pounds.*	*Centals.*
ngary	37,000,000	1874–'82	7,028,418,475	1.90	27,116,883,246	7.34
	5,450,000	1882	2,542,400,959	4.66	5,308,660,999	9.74
	1,950,000	1875–'82	145,704,918	.75	3,149,367,153	16.15
	37,000,000	1872–'83	20,419,402,608	5.64	37,408,006,683	10.11
	45,200,000	1878–'83	7,066,830,311	1.56	37,487,235,572	8.29
in	34,500,000	1874–'83	12,945,181,690	3.75	29,489,954,379	8.55
	27,500,000	1872–'82	8,770,418,065	3.19	14,894,023,876	5.42
	3,950,000	1870–'82	683,635,002	1.73	2,493,816,867	6.31
	4,150,000	1877	523,351,011	1.26	2,009,602,886	4.84
	5,073,000	1876	468,285,695	.....	2,751,066,482	.....
	78,000,000	1870–'81	8,147,169,628	1.04	69,080,603,014	8.86
	4,500,000	1874–'82	269,120,005	.60	3,558,811,394	7.91
	1,775,000	1871–'75	45,842,149	.26	1,063,798,155	5.99

ement includes about 286,000,000 of the population of Europe, and makes the supply centals of wheat and 2,368,000,000 centals of all cereals together. Belgium is represented year. It is believed that an average would be about 4 centals of wheat per head, and 8.5 a. The total population of Europe is about 330,000,000.

supply is obtained mainly from domestic production, in some s in part by importation, and in all there are some imports and which modify the supply. These data have been compiled for of years (published in the monthly report of March, 1885), and age imports and exports, as well as production, give a truer idea al supply than could be obtained from the examination of fluc- annual figures.

wing the average production, imports, exports, and supply of wheat in different countries for the period specified.

ountries.	Period.	Production.	Imports.	Exports.	Supply.
		Pounds	*Pounds a*	*Pounds. a*	*Pounds*
ngary	1874–82	b7,082,962,753	414,702,652	469,246,980	7,028,418,475
	1882	c1,635,168,200	1,577,802,564	670,569,805	2,542,400,959
	1875–82	274,097,768	80,666,863	209,059,713	145,704,918
	1872–83	c18,497,867,361	2,830,981,902	909,446,655	20,419,402,608
	1878–'83	b6,288,551,029	1,426,817,488	648,538,205	7,066,830,311
in and Ireland	1874–'83	d5,678,396,111	7,413,012,499	146,226,920	12,945,181,690
	1872–'82	8,267,892,091	635,069,727	172,564,253	8,770,418,065
	1870–82	b376,204,785	588,256,302	230,825,585	683,635,002
	1877	459,075,000	63,736,613	60,602	523,351,011
nrope	1870–81	11,87[illegible],897,640	.....	3,723,728,012	8,147,169,628
	a,	10,409,425,500	144,959,377	140,106,504	10,414,278,373
	1874–'82	191,535,007	93,871,110	21,286,111	269,120,005
	1871–75	16,514,280	29,327,869	.....	45,842,149

g wheat meal and flour, reduced to their approximate equivalents in wheat.
ncluded with wheat. In the case of Austria-Hungary the quantity of spelt is relatively

aslin are included with wheat.
es do not include the Isle of Man and the Channel Islands.
as to production are taken from Dr. von Neumann-Spallart's, *Uebersichten der Welt-* purport to represent a medium crop for the period 1867 to 1878. The imports and ex- year 1878.

Table showing the average production, imports, exports, and supply of cereals other than wheat in different countries for the period specified.*

Countries.	Periods.	Production.	Imports.a	Exports.a	Supply.
		Pounds.	*Pounds*	*Pounds.*	*Pounds.*
Austria and Hungary b	1874–'82	20,481,219,959	721,077,580	1,093,832,788	20,08[illegible]
Belgium	1882	2,032,191,624	1,206,486,331	474,419,215	2,76[illegible]
Denmark	1875–'82	3,152,621,278	202,443,499	351,402,540	3,00[illegible]
France b	1872–'83	16,584,788,138	1,182,518,413	778,702,473	16,[illegible]
Germany	1878–'83	27,308,083,487	3,831,994,704	719,672,631	30,[illegible]
Great Britain and Ireland c	1874–'83	10,301,553,625	6,852,373,993	109,154,329	16,[illegible]
Italy	1872–'82	6,054,305,533	d201,292,479	191,992,201	6,[illegible]
Netherlands	1870–'82	1,311,446,544	789,447,111	290,711,789	1,[illegible]
Portugal	1877	1,451,749,552	35,923,086	1,420,743	1,[illegible]
Russia in Europe	1870–81	65,398,163,810	[illegible]	4,464,730,424	6[illegible]
Spain	(e)	8,133,219,368	47,328,479	33,328,410	8,[illegible]
Sweden	1874–'82	3,442,335,845	370,397,862	529,542,316	3,[illegible]
Norway	1871–'75	646,632,216	384,894,726	13,875,228	1,[illegible]

* In some cases other than wheat, spelt, and maslin, see notes to preceding table.
a The figures on imports and exports include cereal products reduced to their approximate equivalent in the cereals from which they were respectively derived.
b Millet, of which the amount is comparatively small, is not included.
c The figures as to production do not include the Isle of Man and the Channel Islands.
d Pulse is included with grain in these figures.
e See note a, preceding table.

*Table showing the average production, import, export, and supply of cereals in different countries for the periods specified.**

Countries.	Periods.	Production.	Imports.	Exports.	Supply.
		Pounds.	*Pounds.*	*Pounds.*	[illegible]
Austria-Hungary	1874–'82	27,544,182,713	1,135,780,231	1,563,079,[illegible]	27,[illegible]
Belgium	1882	3,667,359,824	2,786,290,895	1,144,989,720	5,[illegible]
Denmark	1875–'82	2,426,719,046	283,110,302	560,463,253	2,[illegible]
France	1875–'83	35,082,655,498	4,013,500,315	1,688,149,128	37,[illegible]
Germany	1878–'83	33,596,634,516	5,259,812,192	1,868,211,136	37,[illegible]
Great Britain and Ireland	1874–'83	15,979,040,136	13,766,386,402	255,381,249	29,[illegible]
Italy	1872–'82	14,342,198,124	916,382,206	304,556,454	14,[illegible]
Netherlands	1870–'82	1,687,650,829	1,377,703,412	521,537,974	1,[illegible]
Portugal	1877	1,911,424,552	99,659,679	1,421,345	2,[illegible]
Russia in Europe	1870–'81	77,289,061,450	[illegible]	8,186,458,436	69,[illegible]
Spain	(*)	16,542,644,803	192,287,847	173,434,914	16,[illegible]
Sweden	1874–'82	3,634,370,852	469,208,972	544,825,429	3,[illegible]
Norway	1871–'75	663,146,498	414,023,595	13,875,228	1,[illegible]

* See notes to the two preceding tables.

1885—THE CROPS OF THE YEAR.

Notwithstanding the fears of many in the early months of the the season has been a full average of productiveness. It is in five years past to give an average yield of corn, after a pre period of six years of 26 bushels or more per acre. The present ceeds the average about half a bushel per acre.

Oats, allied to corn in its uses, and governed in price more or the supply of maize, also made a high record in the season's repo condition, showing the largest area and greatest volume of pr ever recorded.

Barley is a medium crop, and buckwheat above the average.

Wheat has suffered worse from winter killing than in any fo perience of crop reporting in this Department. The winter of 1 was only less severe, and that of 1873–'74 was nearly as bad. On basis of the area seeded the yield was only 9.2 bushels; on the

, deducting abandoned and replanted areas, which were larger
before, the yield averages 10.4 per acre. The loss was not
ı in the northern belt. Michigan, the highest latitude in which
wheat is grown, suffered less than usual, and made a large crop,
:he best recorded; its surface was well covered with a blanket
until into April. There was some protection in Northern Ohio,
:omparatively good crop on a limited area. The loss in New
as also slight, and not very severe in Pennsylvania, with some
)nal areas of greater damage. The central belt between 36° and
atitude received the full effect of the winter's severity. The
usually exempt from injury by winter freezing, but not en-
past season. The signs of injury in spring were visible even
xtreme South.
n promised a large crop, on an increased acreage, and has made
, medium one, in aggregate volume exceeded by the crop of 1882,
)roached somewhat nearly only by that of 1880.
· crops have enjoyed conditions favoring medium abundance,
me exceptions, notably the potato crop, which was injured se-
)y rot in the latter part of the season.
ether production has been abundant, more than ample for do-
:onsumption, in everything except the products which are always
ent, as sugar, barley, rice, and subtropical fruits.

TEMPERATURE AND RAINFALL.

emperature of April was a full average on the Atlantic coast
Eastern Gulf States, and still higher in the Western Gulf States,
essee, and in all the region west of the Missouri. It was an av-
ı the Ohio Valley and in the Mississippi Valley; and slightly
verage in the Lake region and in Florida. May temperature
iformly lower than an average in all the country east of the
)untain region, and higher thence to the Pacific coast. In
mperature was normal in the East, the South Atlantic States,
ı Gulf States, but low in the Ohio Valley, the Lake region, Up-
sissippi, the Missouri Valley, and extreme Northwest. It was
ı average in July. August was unusually cool throughout the
nd in September somewhat below the average, except in the
est.
l was deficient in April from Pennsylvania to Florida, and es-
)undant in the Missouri Valley. The May precipitation was
ıe standard in all of the States south of New England, normal
hio Valley, and deficient in the Lake regions and the Northwest;
Lower Lake region had an excess in June, as did the East, the
gion, and the Missouri Valley in August. The Southern Atlantic
'ere visited with extreme rainfall in September, while the quan-
small north of Maryland. As a whole, there was a more equal
tion than usual, and greater exemption from droughts. Injuries
ing crops were greater from floods and excessive moisture than
ought.

For a better opportunity to study the peculiarities of the season's meteorology and its influence on vegetable growth and maturation, the following tables from the Signal Service records are presented:

AVERAGE TEMPERATURE.

Districts.	April.		May.		June.		July.		August.		Septem
	Series of years.	1885.	Series of years.	1885.	Series of years.	1885.	Series of years.	1885.	Series of years.	[illegible]	Series of years.
	°	°	°	°	°	°	°	°	°	°	°
New England	43.4	45.0	54.9	53.1	64.3	64.1	69.4	69.7	68.3	66.3	62.1
Middle Atlantic States	49.9	50.6	61.5	59.3	70 7	69.7	75.4	76.1	73.7	73.4	68.0
South Atlantic States	61.2	61 2	70.0	69.1	76.9	76.5	80.5	80.3	78.4	79.0	74.4
Florida Peninsula	72.3	71 0	76.7	75.8	80.8	80.6	82.0	82.2	81.8	81.9	79.0
Eastern Gulf States	65.0	65.4	72.6	70.9	78.7	79.1	81.0	80.2	79.2	78.9	75.0
Western Gulf States	66.4	67 8	73.3	71.2	80.1	80.5	82.5	82.1	81.0	80.9	78.1
Rio Grande Valley	75.8	76.2	80.1	76.2	84.2	83.5	85.6	84.0	83.1	82.1	80.4
Tennessee	58.5	60.1	68.9	65.6	75.9	76.0	79.2	78.4	76.8	76.9	70.2
Ohio Valley	53 5	53.5	65.0	62.6	73.2	70 7	77.1	77.7	74.8	72.6	67.3
Lower Lake region	44.4	43.0	57.2	55.5	67.0	64.1	71.5	71.6	70.4	65.5	60.4
Upper Lake region	39 2	37.6	51.3	48.5	61 5	59.4	67.1	67.2	66.4	61.3	54.0
Extreme Northwest	38.4	40.1	52.4	51 7	62.6	60.4	66.4	66.7	66.0	60.7	54.6
Upper Mississippi Valley	50 7	50 4	62.7	60.1	71 0	69 7	75.5	76.5	73.6	69.6	64.6
Missouri Valley	46.9	48.6	59.2	58.1	69.8	68.3	72.3	74.7	72.6	67.6	62.9
Northern Slope	42.6	45.1	52.4	52.1	62.3	59.3	66.8	66.3	67.2	63.7	55.2
Middle Slope	50.1	52.1	59.6	56.8	70.0	68.6	74.8	74.0	72.7	71.3	63.1
Southern Slope	62.8	63.1	70.3	66.4	77.9	77.5	80.1	79.0	76.9	77.7	.....
Southern Plateau	57.9	59.3	66.6	65.1	75.3	73.7	79.4	79.3	75.4	76.0	68.1
Middle Plateau	48.3	50.0	55.3	55.3	65.9	61.3	73.6	73.3	73.0	73.9	63.3
Northern Plateau	49.3	52.1	56.8	58.4	65.0	63.0	70.9	72.3	70.3	71.3	63.0
North Pacific Coast region	50.2	51.7	55.0	57.3	60.6	60.4	64.4	66.7	64.1	64.3	63.1
Middle Pacific Coast region	57.0	59.9	59.2	61.2	64.6	62.1	66.8	67.2	66.4	67.2	67.1
South Pacific Coast region	61.5	64.2	66.6	63.3	71.0	70.1	75.9	77.0	69.1	73.2	67.1
Mount Washington, N. H.	20.9	23.0	33.5	36.1	48.9	46.2	.....	.....	.....	.....	.....
Pike's Peak, Colo	12.6	15.3	21.9	21.1	33.7	29.3	.....	.....	.....	.....	.....

AVERAGE RAINFALL.

	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.
New England	3.60	3.13	3.70	3.51	3.76	3.33	4.42	2.31	3.42	6.41	3.93	
Middle Atlantic States	3.69	1.81	2.88	3.09	3.50	2.31	4.24	2.98	4.91	4.88	3.09	
South Atlantic States	4.64	2.16	3.52	6.84	5.01	5.80	5.73	4.68	4.80	7.67	5.04	
Florida Peninsula	2.61	0.62	3.15	4.67	6.20	7.46	5.56	0.25	7.67	6.74	5.22	10.
Eastern Gulf States	5.87	4.32	4.45	7.05	4.94	4.23	4.88	5.08	5.44	5.43	4.21	
Western Gulf States	4.60	5.88	5.39	6.07	3.53	2.97	3.96	4.01	3.02	1.82	4.35	
Rio Grande Valley	0.76	1.58	2.88	3.72	1.60	0.27	1.97	0.73	4.66	1.52	4.46	
Tennessee	5.82	2.57	3.80	4.93	4.57	3.62	4.03	4.73	3.77	3.71	3.34	
Ohio Valley	3.50	3.73	3.90	3.70	4.44	4.22	4.51	1.99	3.37	4.61	2.56	
Lower Lake region	2.36	2.44	3.25	3.90	3.76	5.25	3.80	3.27	3.06	3.10	3.06	
Upper Lake region	2.02	1.98	3.67	2.40	4.23	4.04	3.50	2.92	3.11	3.22	3.70	
Extreme Northwest	1.86	2.42	3.00	1.47	3.62	4.82	3.22	3.21	2.13	1.61	2.35	
Upper Mississippi Valley	2.97	3.42	4.43	2.48	5.63	5.04	4.14	4.05	3.21	5.46	3.57	
Missouri Valley	3.08	4.19	3.10	4.10	4.32	4.29	4.06	4.09	3.02	6.04	2.27	
Northern Slope	1.61	1.45	2.43	1.40	2.23	4.16	1.96	1.04	1.38	1.85	1.14	
Middle Slope	1.34	2.61	1.69	4.51	3.49	4.04	3.40	3.23	2.58	4.17	1.89	
Southern Slope	1.37	1.90	3.12	3.19	2.98	4.18	3.14	1.71	3.67	3.06	.....	
Southern Plateau	0.48	0.41	0.46	0.55	0.42	0.60	2.24	1.30	2.08	1.69	1.18	
Middle Plateau	1.74	2.24	1.52	1.76	0.70	2.64	0.38	0.29	0.47	0.47	0.42	
Northern Plateau	1.86	0.15	1.50	2.67	1.20	2.74	0.58	0.19	0.29	0.19	0.79	
North Pacific Coast region	3.88	0.88	2.23	3.48	1.34	1.30	0.70	0.47	0.60	trace	1.04	
Middle Pacific Coast region	3.10	1.19	0.92	0.32	0.35	0.75	0.06	0.11	0.04	0.20	0.30	
South Pacific Coast region	0.98	1.09	0.35	0.22	0.10	0.02	0.07	0.17	0.10	0.06	0.02	
Mount Washington, N. H.	4.28	2.66	6.85	2.29	9.45	11.34	.....	.....	.....	.....	.....	
Pike's Peak, Colo	3.32	5.39	4.01	6.12	1.83	1.39	.....	.....	.....	.....	.....	

Grouping the more important agricultural districts of the South-West, and comparing the record of 1885 with the average, the pe

ties of the season's temperature and rainfall in the several districts is nade easily apparent:

Months.	South Atlantic.		Western Gulf.		Ohio Valley.		Missouri Valley.		Extreme Northwest.	
	Temperature.	Rainfall.	Temperature.	Rainfall.	Temperature.	Rainfall.	Temperature.	Rainfall.	Temperature.	Rainfall.
	°	*Inches.*	°	*Inches.*	°	*Inches.*	°	*Inches.*	°	*Inches.*
April.....	0.0	−2.48	+1.4	+1.28	0.0	+0.23	+1.7	+1.11	+1.7	+0.56
May.....	−0.9	+2.82	−2.1	−0.32	−2.4	−0.20	−1.1	+0.11	−0.7	−1.59
June.....	−0.4	+0.79	+0.4	−0.56	−2.5	−0.22	−1.5	−0.53	−2.2	+1.20
July.....	−0.2	−1.09	−0.4	+0.05	+0.6	−2.61	+1.4	−0.07	+0.3	−0.91
August.....	+0.6	+1.37	−0.1	−2.10	−2.2	+1.24	−4.8	+3.02	−5.3	−1.52
September.....	−1.0	+1.30	−0.3	+3.78	−1.4	+0.96	+0.4	+1.20	+0.4	−1.16

CORN.

In consequence of the injury to wheat, the maize acreage was in- ed more than usual.

ıne area of last year, as estimated, was 69,683,780 acres; this year 73,130,150 acres, an increase of 5 per cent. The crop had a favorable start. July condition averaged 94 per cent. against 96 in 1884 and 100 in 1880. High condition in July is not absolutely essential to the production of a large crop, yet it is a favorable indication. During the six consecutive years of large production, condition in July reached 100 but only in one instance, in 1877, was lower than in July of the t year.

ıt was shown that there had been a large amount of replanting ughout the West, partly because of defective seed used and partly ount of excessive moisture in the seed bed, and a prevalence of worms that seems to have been somewhat unusual. The lessons of few years have been expensive, but they have not taught all rs the economy of a careful and timely selection of seed, though en has been done in that direction by thoughtful farmers. An im- e amount of labor has been lost this season in replanting because poor seed.

There was an excess of moisture in low-lying lands at the planting and germinating period, as well as that of early growth, in a large portion of the breadth, yet the ardent suns of the last week in June evaporated rapidly the excess of moisture and greatly improved the appearance of the crop, so that growth was generally luxuriant and the color a healthy green at the time of observation for the July report.

The August report showed an improvement in condition which carried average to 96. In some sections temperature was very high and sture deficient a part of the month; yet improvement continued, wing that high heat, without deficient moisture often benefits corn ner than injures it.

ın the latter part of July rains were general, insuring against very ious drought for the remainder of the season, and guaranteeing, in the ence of frost, at least a medium rate of yield.

ıhe returns of the 1st of September showed that drought in the South- n States had wrought some injury in the light soils; on the north- ler maturity had been delayed by heavy rains and cool nights, ught frosts in high latitudes; yet average condition had been re- only by a single point, and the crop in the absence of killing s assured. The growing season, from germination to harden-

ing of the grain, had been characterized by a moderately high temperature and sufficient moisture, with local exceptions, for healthful growth and full maturity. The meteorological conditions of the summer had been more favorable, on the whole, than any prior season since 1880, and the promise accordingly of a somewhat larger rate of yield was reasonably sure. It is more and more apparent that agricultural meteorology, in connection with corn-growing, is of equal importance with soil constituents, and that failure results from abnormal temperature and rainfall than from lack of fertility.

Insects caused no general or serious damage. In the Ohio V and in the Lower Missouri Valley grasshoppers were abundant, cau local injury. Chinch-bugs were also reported, especially in M and Texas—in some localities in immense numbers.

The October report announced the maturity of the crop, and a yield a little above the average condition, being 95, one point higher tha July, making a record of great uniformity through the season, ho its early status, and even improving it as the season lengthened.

There was exemption above the average from frost, and therefore a smaller proportion than usual of soft corn. In an average of series of years one-fifth of the crop is unmerchantable, from frost and other causes of immaturity; in bad seasons, two-fifths. This year has witnessed no losses from frost except upon the northern border. Corn is so general a crop in all latitudes, and at elevations in some instar up to 6,000 feet or more, that frost catches some of it in the most favorable seasons.

The product of corn as estimated is 1,936,176,000 bushels agai 1,795,528,000 last year, an increase of 140,648,000 bushels, or 7.8 cent.

The yield is 26.5 bushels per acre, against 25.8 last year, whi very nearly an average crop. That of 1882 averaged 24.6, 18 22.7, and the still worse crop of 1881 the low yield of 18.6 bushels acre. The present year is the first in five that passes a full ave rate of yield. The price is little more than half that of 1881, whi 63.6 per bushel.

The valuation is 32.8 cents per bushel, instead of 35.7 cents last year, and the aggregate value is $635,674,630, less by about $5,000,000 than the smaller crop of 1884. The record of estimates by States is as follows:

States and Territories.	Acres.	Bushels.	Value.
Maine	31,222	1,000,000	[illegible]
New Hampshire	38,386	1,299,000	[illegible]
Vermont	61,488	1,979,000	[illegible]
Massachusetts	57,008	1,961,000	[illegible]
Rhode Island	12,818	429,000	[illegible]
Connecticut	58,140	2,033,000	[illegible]
New York	731,196	22,448,000	[illegible]
New Jersey	350,370	11,212,000	[illegible]
Pennsylvania	1,417,030	46,074,000	[illegible]
Delaware	216,505	4,174,000	[illegible]
Maryland	726,386	15,990,000	[illegible]
Virginia	2,132,230	31,838,000	[illegible]
North Carolina	2,545,126	25,199,000	[illegible]
South Carolina	1,487,341	13,453,000	[illegible]
Georgia	2,857,700	32,162,000	[illegible]
Florida	420,070	3,799,000	[illegible]
Alabama	2,340,114	31,405,000	[illegible]
Mississippi	1,927,392	25,765,000	[illegible]
Louisiana	917,377	15,410,000	[illegible]
Texas	4,090,443	84,406,000	[illegible]
Arkansas	1,898,327	38,309,000	[illegible]
Tennessee	3,569,590	75,381,000	[illegible]
West Virginia	665,400	[illegible]	[illegible]

States and Territories.	Acres.	Bushels.	Value.
.....	3,551,807	60,559,000	$31,890,150
.....	3,017,461	111,865,000	35,796,800
.....	938,682	30,706,000	10,440,040
.....	3,720,681	51,004,000	38,278,280
.....	8,569,070	168,998,000	75,319,440
.....	1,088,019	32,750,000	21,135,000
.....	648,903	18,431,000	5,897,920
.....	7,549,542	241,486,000	58,199,040
.....	6,295,728	195,861,000	49,215,250
.....	4,884,550	158,308,000	38,013,000
.....	3,526,475	129,426,000	24,590,940
.....	155,700	3,840,000	2,611,200
.....	6,479	148,000	103,600
.....	847	21,000	15,750
.....	27,830	959,000	652,120
.....	2,993	66,000	49,500
.....	530,100	15,345,000	4,296,600
.....	1,911	41,000	23,620
.....	880	22,000	17,600
.....	47,672	979,000	763,620
.....	18,742	409,000	245,400
.....	3,371	89,000	63,190
.....	73,130,150	1,936,170,000	635,674,630

WHEAT.

story of the last wheat crop represents it as unfortunate, from to harvest. The soil was in bad condition on the Atlantic m New Jersey to Georgia, and in West Virginia and Tennes- was better in the Southwest and in Missouri, Illinois, and i. In the Ohio Valley it was scarcely in a medium condition. i New England was rather dry for seeding, but the soil was . in fine condition, and the fall growth moderately good. Con- f seeding were generally favorable in New York. In New Jer- oil was hard, germination slow, and growth small. The effect ht was similar along the Atlantic coast, and on the Gulf coast vas also dry, but autumn growth was better than in the States ast. Texas reported better condition than any other Southern n the Ohio Valley the surface was impacted by drought at ints, yet there were many reports of fine growth. In Illinois ›uri these were more general, and superior condition of soil a development were reported of large districts. In parts of the soil was too dry for germination; in others, as in Dickin- naha, Ottawa, Cherokee, Pottawatomie, and many other coun- nination was prompt and fall growth good.

erage date of seeding was as follows:

Average date of seeding.

e.	From—	To—	Average date.	State.	From—	To—	Average date.
.....	Sept 1	Oct 25	Sept 25	Arkansas.....	Sept. 1	Jan. 10	Nov 1
.....	Aug 15	Oct 15	Sept 15	Tennessee	Sept. 1	Dec. 20	Oct. 22
.....	Aug. 25	Oct 25	Sept. 25	West Virginia.....	Sept. 1	Nov. 15	Oct. 2
.....	Aug 10	Oct. 30	Sept 19	Kentucky	Sept. 1	Dec. 10	Oct. 12
.....	Sept 15	Nov 1	Oct. 10	Ohio	Aug 25	Nov. 15	Sept. 24
.....	Aug 20	Nov. 20	Oct. 13	Michigan	Aug. 20	Nov. 1	Sept. 15
.....	Sept. 5	Dec. 1	Oct 19	Indiana	Aug. 20	Nov. 20	Sept. 24
.....	Sept. 1	Dec. 15	Nov. 5	Illinois	Aug. 25	Nov. 13	Sept. 23
.....	Oct. 1	Dec. 10	Nov. 13	Missouri.....	Aug. 15	Dec. 1	Sept. 29
.....	Sept. 1	Dec. 25	Nov 14	Kansas	Aug. 15	Dec. 1	Sept. 24
.....	Sept. 15	Jan. 1	Nov 7	California.....	Sept. 1	May 1	Dec. 27
.....	Sept. 15	Dec. 30	Nov. 5	Oregon	Sept. 15	Apr 1	Nov. 26
.....	Sept. 1	Feb. 1	Nov. 6				

Had the winter been propitious there might still have been a good crop. South of the latitude of 40° there was little protection by snow, temperature was variable, occasional snows disappeared and sheets of ice covered the level or low surfaces, and freezes succeeded t ws in later winter, resulting in the destruction of the plants to a degree unprecedented. The April report was very unfavorable, yet not so unpromising as that of May, as the amount of damage could not be determined so early. It not unfrequently happens that improv follows if the roots are less injured than the blackened blades indi and April weather proves favorable. In this instance the breaki the roots was worse than appearances indicated, yet the returns were interpreted to mean an apparent injury of 26 per cent. It was apparent in May that the loss would be still greater. A reduction of 149, bushels was reported as early as the 1st of June, and a probable y of 207,000,000 bushels, which is less by 4,000,000 or 5,000,000 the final estimates of total product.

The first report of spring wheat, June 1, was more favorable, indicating a product of 153,000,000 bushels. The occurrence of extr heat in midsummer reduced this expectation to the extent of 8,000 bushels, notwithstanding a considerable increase in Dakota due to revelation of an increase of acreage beyond previous calculation in 18

The California crop, so uniformly overestimated in local reports y after year, makes this year a product of little more than [illegible] bushels, or two-thirds of the quantity reported in local estimat

The result as given below shows a decline of 30 per cent. fr aggregate of last year, a reduction in harvested acres of n [illegible] 5,000,000, and a value increased from 65.7 cents per bushel to [illegible]

The following statement gives the details by States:

States and Territories.	Acres.	Bushels.	Value.
Maine	41,126	566,000	[illegible]
New Hampshire	11,267	174,000	
Vermont	22,007	390,000	
Massachusetts	1,080	17,000	—
Rhode Island			
Connecticut	2,193	31,000	[illegible]
New York	687,367	10,565,000	10,[illegible]
New Jersey	143,097	1,395,000	1
Pennsylvania	1,380,294	13,325,000	12
Delaware	89,103	657,000	
Maryland	580,482	5,534,000	[illegible]
Virginia	651,140	2,833,000	[illegible]
North Carolina	682,868	2,790,000	[illegible]
South Carolina	220,030	1,170,000	1
Georgia	453,375	2,817,000	2,
Florida			
Alabama	239,467	1,307,000	1,[illegible]
Mississippi	38,448	190,000	
Louisiana			
Texas	545,468	6,117,000	[illegible]
Arkansas	240,997	1,565,000	[illegible]
Tennessee	1,175,882	8,821,000	[illegible]
West Virginia	268,961	1,493,000	[illegible]
Kentucky	1,055,760	3,759,000	[illegible]
Ohio	2,018,952	20,593,000	[illegible]
Michigan	1,623,929	21,261,000	[illegible]
Indiana	2,518,455	26,659,000	[illegible]
Illinois	1,255,005	10,683,000	[illegible]
Wisconsin	1,362,783	15,665,000	[illegible]
Minnesota	3,084,274	34,285,000	[illegible]
Iowa	2,683,944	30,332,000	[illegible]
Missouri	1,517,698	11,275,000	[illegible]
Kansas	1,060,250	11,197,000	[illegible]
Nebraska	1,758,282	19,828,000	[illegible]
California	2,822,400	26,502,000	[illegible]
Oregon	876,102	12,916,000	[illegible]
Nevada	5,570	108,000	[illegible]
Colorado	[illegible]	[illegible]	[illegible]

States and Territories.	Acres.	Bushels.	Value.
	21,578	303,000	$287,850
	2,187,094	27,913,000	17,585,190
	62,870	1,154,000	865,500
	88,884	1,715,000	1,320,550
	73,942	1,028,000	1,043,460
	96,861	1,926,000	1,174,860
	424,276	7,412,000	5,330,640
	3,180	66,000	52,800
	94,189,248	357,113,000	275,320,296

OATS.

. of oats, like that of corn, was enlarged by substitution for . destroyed, and the entire increase is estimated at 7 per cent., ge being 22,783,630 acres instead of 21,300,917 last year.
st report of condition, in June, was quite favorable, the aver- 94, a figure not so high as in each of the recent years since increased, however, in July and August, and the condition vested was 93, indicating a full average for a series of years. ated yield is 27.2 bushels per acre, while the less prolific crop sus year was 25.3. The average of the estimates of eleven '1 to 1881, inclusive, is 27.6 bushels. The farm price is lower, hy with the decline in corn, averaging 28.5 cents per bushel, egating $179,631,860. As the decline in value of corn, from ge of the period above to the present year is 23.8 per cent., so of oats suffers a decline of 21 per cent. from 36.1 to 28.5 cents.

Oats, 1885.

States and Territories.	Acres.	Bushels.	Value.
	84,570	2,622,000	$1,048,800
	31,506	1,092,000	458,640
	104,565	3,800,000	1,406,220
	24,297	783,000	323,700
	6,353	167,000	73,480
	38,282	1,090,000	457,800
	1,385,245	38,676,000	13,923,360
	177,451	3,550,000	1,315,720
	1,304,021	34,520,000	12,357,360
	27,197	502,000	190,760
	111,100	2,475,000	866,250
	251,230	8,664,000	3,552,240
	599,117	4,483,000	2,241,500
	413,963	8,619,000	1,895,400
	709,640	6,395,000	3,389,350
	58,611	619,000	247,600
	401,772	4,191,000	2,054,100
	355,091	3,902,000	2,[illegible]00
	6,857	42,000	15,540
	5,242,006	94,214,000	5,[illegible]70
	251,184	5,413,000	2,[illegible]50
	620,090	10,752,000	3,[illegible]80
	138,039	2,831,000	900,850
	491,545	10,225,000	3,374,250
	1,003,680	37,470,000	10,[illegible]00
	615,800	21,789,000	6,[illegible]20
	1,014,680	27,178,000	9,794,500
	3,290,081	107,048,000	25,012,420
	1,412,474	47,778,000	12,[illegible]80
	1,076,393	37,544,000	9,386,000
	2,210,338	74,718,000	16,437,960
	1,267,849	28,912,000	7,361,120
	853,920	27,145,000	6,243,350
	700,048	24,028,000	4,565,320
	78,008	2,106,000	1,010,880
	198,397	5,795,000	2,145,260

Oats, 1885—Continued.

States and Territories.	Acres.	Bushels.
Nevada	7,858	271,000
Colorado	45,478	1,698,000
Arizona	.....	.....
Dakota	352,800	13,229,000
Idaho	34,088	1,032,000
Montana	53,560	1,775,000
New Mexico	13,841	282,000
Utah	27,687	845,000
Washington	80,357	3,095,000
Wyoming	2,625	84,000
Total	22,783,630	629,409,000

OTHER CEREALS.

Rye suffered from winter killing, though less than wheat, average of 83 in June, which improved to 87 at harvest, wn somewhat below the usual yield was secured. The spring ci more promising. The June average for barley was 89, July 9: average reported at harvesting was 88, which was nine points lc the harvest report of the previous crop. Buckwheat was inc breadth and enjoyed favorable conditions, producing a fair y large area, the October report of condition being 92.

POTATOES.

The early prospect for potatoes was fine. Condition in July 97. In moist lands in the Northern and Western States there complaint of seed rotting in the hill. A decline soon set August average was 95, that of September 93, while October on account of the rot in New York and elsewhere, which incre idly before digging, causing the loss of whole fields. Excess ure favored the extension of the disease. The beetle was re all sections, especially in the Western States, but was not structive. A small crop is the result, with higher prices, whic still higher should the stock which is winter-stored prove unsc

COTTON.

The area of cotton has been increased about 5 per cent. area now slightly exceeds 18,000,000 acres. The tendency to ex westward, especially active beyond the Mississippi. In June, plant, a good stand, cultivation somewhat retarded by rain, wi tion at 92, were the essential features of the report. During Ju rial improvement was made, temperature and rainfall favored and by July 1 fruiting had commenced in the Gulf Stat droughts were very rare up to this date, and moisture w ample, and in low grounds somewhat excessive. Condi n averaging 96; promising, the later season being favorable, a l This status continued until early in August, when shedding began to indicate a loss of vitality, in some places from dr others from deluging rains, and at many points from attacks c erpillar or boll-worm. A marked decline was manifest in Se when the average was reduced to 87. Drought in Texas, A

ern Tennessee, and in Alabama, Georgia, and the Carolinas had proved injurious. Florida, Mississippi, and Louisiana had better "seasons." In October condition was still further reduced to 78. The returns of October also included local estimates of yield per acre in hundredths of a bale. These were: Virginia, 32; North Carolina, 38; South Carolina, 35; Georgia, 35; Florida, 23; Alabama, 30; Mississippi, 41; Louisiana, 43; Texas, 38; Arkansas, 42; Tennessee, 35. The average was about 36¾ hundredths of a bale per acre, or nearly 6⅞ million bales. The November returns were local estimates of yield per acre, in pounds, which were somewhat lower, looking to a yield of about 6½ million bales. The top crop had proved light, and at some places scarcely appreciable, a tone of disappointment in the result was apparent. The weather had been favorable for picking, except in the eastern belt, where rains had obstructed the harvest and injured the fiber. The December returns, those of final product, always conservative in their unrevised condition, showing 8 to 10, and in years of sudden or severe depression, 2 to 15 per cent. less than the real yield, were not indicative of a crop large as that promised in October. The final returns are made on 1st of February.

The special cotton returns of February 1, 1886, estimate the cotton ning on plantations on the 1st of February, the proportion of lint d, the quality, average date of close of picking, and the price of otton seed.

The time of closing of cotton picking varied greatly in every State, later than in 1884 or 1883 in nearly all. The average date of g was in November, in 1884, in nine States, and in eight States in 883, but in 1885 it was in December in all but South Carolina, Florida, nd Alabama. On an average the close of picking was about nine ays later than in previous year. The average dates in each State for he three years are thus given:

States.	1885.	1884.	1883.
inia	Dec. 11	Dec. 6	Dec. 12
h Carolina	Dec. 2	Nov. 25	Nov. 28
th Carolina	Nov. 30	Nov. 20	Nov. 23
gia	Dec. 3	Nov. 19	Nov. 20
ida	Nov. 25	Nov. 30	Nov. 30
ama	Nov. 28	Nov. 24	Nov. 24
issippi	Dec. 8	Nov. 23	Nov. 26
isiana	Dec. 10	Nov. 28	Nov. 23
as	Dec. 3	Nov. 20	Nov. 30
kansas	Dec. 4	Dec. 4	Dec. 12
nessee	Dec. 10	Nov. 30	Dec. 10

The returns relating to quality of the present crop make the cotton Texas and Arkansas better than usual, and give the lowest averages Georgia and Alabama, while that of the Carolinas is next in inferior, and that of Tennessee, Mississippi, and Louisiana nearly an average. he staple is generally short, especially in the districts that report inor quality. On the Atlantic coast there is much complaint of injury us and storms, and by hurried picking between storms on clay as. The weather was not generally favorable for picking in this on. Going west improvement is indicated, and in the extreme nearly perfect weather for picking was generally enjoyed.

returns of percentage of lint to seed mark a similar difference in ity, d attest a general average somewhat below medium quality. e should be at least 32 per cent. of lint, or between 32 and y the States beyond the Mississippi make an average exceed-

ing 32 per cent. Mississippi and Florida give 32, and the others not much in excess of 31. This indicates a reduction of 2 or 3 per cent. in the ultimate yield of cotton as compared with the quantity of seed-cotton gathered, and may decrease the product to that extent below the expectation at picking time—a difference, possibly, of 75,000 bales.

The following is a tabulation of State averages, relating to quality, quantity marketed, and price of seed sold:

State.	Lint.	Quality.	Proportion marketed.	Price of seed per bushel.
	Per cent.	*Per cent.*	*Per cent.*	*Cents.*
Virginia	31.0	92	82.0	15
North Carolina	31.0	92	82.0	15
South Carolina	31.5	93	84.0	15
Georgia	31.0	90	85.0	15
Florida	32.0	98	87.0	20
Alabama	31.0	91	84.0	14
Mississippi	32.0	94	83.5	12
Louisiana	32.5	97	83.5	11
Texas	32.5	101	83.0	12
Arkansas	32.0	100	83.0	11
Tennessee	31.0	98	82.0	13

The average price of seed is less than formerly, scarcely 13 [illegible] bushel. Planters are declining to sell at such a price, and many disposed to deprecate the practice of selling seed, because, as a nothing is returned in place of it, and the fear is expressed t fertility of the soil will suffer in consequence. The lint takes from the soil; the seed is far more exhaustive.

The quantity on the plantations February 1 is apparently about sixth of the crop, five-sixths having gone forward, app[illegible]ng at ports about February 5. The percentage of the crop [illegible] is follows: Virginia, 82; North Carolina, 82; South Carolina, 84; Geo 85; Florida, 87; Alabama, 84; Mississippi, 83½; Louisiana, 83½; Te 83; Arkansas, 83; Tennessee, 82. General average, nearly 83.

The indications thus point to a crop approximating the Nover estimates of yield per acre, which looked to a product slightly e ing 6,500,000 bales.

The returns of February 1, 1885, for the crop of 1884, were interpreted to indicate a crop of 5,667,000 bales. The *Financial Chronicle* record of the movement, up to September following, aggregated 5,669,020 bales, and that of the National Cotton Exchange 5,706,165 bales. As 20,000 to 30,000 bales of the present crop were apparently included in this movement, the figures of last February may as well stand as the permanent record of the actual crop of 1884.

WINTER WHEAT.

The area sown in winter wheat has been the subject of inquiry in the territory which produces it. It has been increasing in recent years, but the low prices of the crops of 1884 and 1885 have naturally had a discouraging effect upon wheat growing, though the persistency of the habit of the farmer's distribution of crop areas is too strong to admit of sudden changes. Like the cotton-grower, the wheat-raiser may threaten reduction, and depend upon his neighbor to make it. There appears however to have been some reduction in several States, mainly in the regions from Illinois westward, which grow wheat largely in excess of the requirements of local consumption. In the States which grow enough, or

ial supply only for home use, there is no necessity for reducing uction, which is only made as a part of a necessary system of rota- or at least of distribution of crop areas, and we find as a rule that s has been no reduction in these States. It is wise rural economy strict the present wheat area, which may still be found too large rofit, should the coming season be favorable to large production. rther returns of the area of winter wheat, for the harvest of 1886, be published in the April report.

ie following table exhibits the proportions of last season's seeding e areas of the present crop, according to the December returns:

States.	Per cent.	States.	Per cent.	States.	Per cent.
York	96	Georgia	91	Ohio	101
ersey	100	Alabama	93	Michigan	101
lvania	101	Mississippi	90	Indiana	103
are	100	Texas	100	Illinois	87
and	101	Arkansas	92	Missouri	95
ia	104	Tennessee	98	Kansas	93
Carolina	105	West Virginia	100	California	99
Carolina	100	Kentucky	98	Oregon	81

FARM PRICES.

ie December returns give local estimates of the farm prices of the ipal crops. The increase in the product of corn has reduced the value of the crop to 33 cents per bushel. The average value previous crop in December was 36 cents. The reduction is larg- n the Ohio Valley and in the Southern States. West of the Missis- i the increase of stock-feeding has corrected the tendency to ex- ly low prices. The average in Missouri is 25 cents, 1 cent lower year. In Kansas it is 24 instead of 22 last year; in Iowa, 24 of 23; in Nebraska, 19 instead of 18. It is 28 cents in Dakota, us lov than last year; 32 in Minnesota, 1 cent lower; Illinois, 28; ; Ohio, 32; Michigan, 34; Kentucky, 35; Pennsylvania, 49; York, 58.

mpared with former prices, corn values are very low. For the pre- ig five years, nearly all under average in production, the average value was 44.7 cents per bushel, and for the preceding ten years cents.

price of wheat, though still low, is considerably above last De- er's average, which was 65 cents. That of 1883 was 91 cents. The t is 77.1 cents, a gain equal to half the unprecedented decline in- last December. For the five years past the average farm value . 90 cents per bushel, and for the preceding ten, $1.05. Last 's farm value was 38 per cent. lower than for the ten years ended in due mainly to a fuller European production and a smaller foreign and for a surplus nearly equal to a third of the entire crop.

range of State prices is from 57 cents in Nebraska to $1.25 in nusetts. It is above $1 in several Eastern and Southern States e-grown wheat. The price in Texas, 80 cents, is 7 cents lower ast December, from the increase in the home crop. The value in York is 96, an increase of 11 cents; Pennsylvania 95, an increase ts; Ohio 91, an increase of 16 cents; Kentucky 95, an increase of ; Michigan 84, an increase of 10 cents; Indiana 86, an increase nts; Illinois 81, an increase of 18 cents; Wisconsin 76, an in- of 16 cents; Minnesota 70, an increase of 20 cents; Iowa 67, an 12 cents; Missouri 77, an increase of 15 cents; Kansas 65,

an increase of 20 cents; Nebraska 57, an increase of 15 cents; 63, an increase of 17 cents. The average for California is retu 67 cents, and 69 for Oregon.

The average price of rye is 56 cents, 4 cents more than last y barley 56 cents, an increase of 7 cents; of buckwheat 56 cents, crease of 3 cents; of potatoes 45 cents, an increase of 5 cents; $8.62 per ton, in place of $8.17 last year. The average price of 28 cents, the same as last December.

The price of cotton averages 8.3 cents per pound of lint, farm which is 9 mills less than the December price last year. The prices are: Virginia, 8.5 cents; North Carolina, 8.5; South Carol Georgia, 8.5; Alabama, 8.3; Mississippi, 8.4; Louisiana, 8.3; Te Arkansas, 8.1; Tennessee, 8.

The average prices, by States, for the crops reported are as fo

Table showing price of farm products December 1, 1885.

States and Territories.	Corn.—Average price per bushel Dec. 1, 1885.	Wheat.—Average price per bushel Dec. 1, 1885.	Rye.—Average price per bushel Dec. 1, 1885.	Oats.—Average price per bushel Dec. 1, 1885.	Barley.—Average price per bushel Dec. 1, 1885.	Buckwheat.—Average price per bushel Dec. 1, 1885.	Potatoes (Solanum tuberosum).—Average price per bushel Dec. 1, 1885.	Potatoes (Batatas edulis), sweet.—Average price per bushel Dec. 1, 1885.	Leaf tobacco.—Average price per pound Dec. 1, 1885.	Hay.—Average price per ton Dec. 1, 1885.	Cotton.—Average price per pound Dec. 1, 1885.
Maine	$0 70	$1 25	$0 57	$0 40	$0 69	$0 54	$0 42	$0 50	.....	$11 95	.....
New Hampshire	71	1 24	63	42	69	58	44	.....	.....	12 75	.....
Vermont	64	1 31	74	37	76	53	35	.....	.....	11 00	.....
Massachusetts	70	1 25	81	43	72	55	67	.....	$0 12 0	18 50	.....
Rhode Island	72	.....	82	44	74	55	56	.....	.....	18 30	.....
Connecticut	63	1 05	75	42	73	60	55	.....	12.4	18 00	.....
New York	58	96	67	36	71	53	45	75	10.0	12 75	.....
New Jersey	53	95	65	37	.....	60	54	66	.....	16 50	.....
Pennsylvania	49	96	66	30	63	54	47	90	10.5	13 50	.....
Delaware	40	95	70	38	.....	50	50	40	.....	15 50	.....
Maryland	46	91	65	35	45	60	45	56	07.3	13 75	.....
Virginia	47	93	67	41	65	61	51	50	07.4	13 23	[illegible]
North Carolina	55	1 00	85	50	.....	65	57	41	10.6	11 68	.....
South Carolina	56	1 10	1 00	54	1 10	.....	75	43	.....	13 75	.....
Georgia	58	1 09	1 13	53	1 10	75	94	44	.....	13 84	08
Florida	70	.....	1 37	67	.....	.....	1 10	51	.....	20 00	*17
Alabama	55	1 03	1 10	54	1 40	.....	97	43	.....	12 73	08
Mississippi	56	1 04	1 00	55	.....	.....	85	50	.....	11 75	08
Louisiana	53	.....	1 20	47	.....	.....	84	47	.....	11 00	08
Texas	49	80	67	37	54	.....	90	71	.....	10 78	08
Arkansas	46	1 00	90	45	75	.....	66	55	.....	11 00	08
Tennessee	39	95	76	34	62	66	46	46	07.0	11 67	08
West Virginia	45	1 01	70	35	55	61	43	71	07.6	12 41	.....
Kentucky	35	95	71	33	67	70	42	58	08.5	10 25	.....
Ohio	33	91	60	27	67	65	39	73	08.3	11 44	.....
Michigan	34	84	59	28	60	56	34	75	.....	10 71	.....
Indiana	29	86	59	25	55	65	36	75	.....	7 79	.....
Illinois	28	81	53	24	57	64	42	70	09.0	7 35	.....
Wisconsin	34	76	52	26	47	66	47	.....	09.5	7 00	.....
Minnesota	32	70	48	25	41	70	40	.....	.....	4 65	.....
Iowa	24	67	46	22	39	68	41	90	.....	4 85	.....
Missouri	25	77	56	26	52	68	39	72	.....	7 25	08
Kansas	24	65	40	23	34	63	38	90	.....	4 25	.....
Nebraska	19	57	33	19	33	65	34	.....	.....	3 51	.....
California	68	67	.....	48	79	.....	63	.....	.....	11 50	.....
Oregon	70	69	75	37	49	60	86	.....	.....	8 66	.....
Nevada	75	92	..	47	81	.....	70	60	.....	7 25	.....
Colorado	68	82	67	46	60	.....	61	.....	.....	9 90	.....
Arizona	75	95	.....	.....	.....	.....	.....	.....	.....	.....	.....
Dakota	58	63	56	23	37	70	42	.....	.....	3 94	.....
Idaho	82	.....	.....	40	.....	.....	47	.....	.....	.....	.....
Montana	80	75	.....	42	77	.....	90	.....	.....	10 27	.....
New Mexico	78	1 02	.....	40	85	.....	32	.....	.....	14 50	.....
Utah	60	61	51	36	52	.....	36	.....	.....	5 97	.....
Washington	71	72	63	33	48	.....	.....	.....	.....	7 14	.....
Wyoming	.....	80	.....	44	.....	.....	.....	.....	.....	.....	.....

*Including sea island.

FLAX.

T n flax has declined heavily, in recent years, in Ohio, Indiana, ıınn ıd increased largely in Minnesota, Iowa, Kansas, Ne- ı, ıı ı kota. The crop of the present year is about 50 per ı. ;er than that of the census year, or nearly 11,000,000 bushels ıı apparently. There is little now produced in any Eastern State. been seeded in preference to wheat on large areas of the North- ε during recent years.

A comparison of the returns of the United States Census of 1880, for crop year 1879, with the returns of several of the flax-growing States r 1884, exhibits these local changes of crop area in a striking light. shows a tendency to enlargement of flax culture on the virgin soils the once Western States, and to reduce it on soils which have been r in cultivation.

States.	1879 (U. S. Census).	1884 (State returns).	
	Seed.	Acres.	Seed.
	Bushels.		*Bushels.*
.....	593, 217	16, 324	131, 532
is.....	1, 812, 438	30, 998	272, 845
sota	98, 689	109, 335	*826, 281
.....	1, 511, 131	300, 000	2, 700, 000
nsas.....	513, 316	131, 513	1, 315, 130
raska	77, 805	34, 694	382, 747
ota.....	26, 757	.....	†2, 882, 788

* Crop of 1883. † Crop of 1885.

the Ohio Valley there is objection to flax on the score of injury to l. "It is hard on the land," is a common remark of correspond- . It was deemed a profitable crop between 1860 and 1868, when ı was high and the fiber was in demand. Now the fiber is either or sold for $3 to $6 per ton, when it can be sold at all. The ;e of seed is likewise reduced. Some farmers object to the crop on ound that it increases the labor at harvest time.

ı. of the Mississippi, where the surplus of cereals is mostly ob- ıı, low prices have turned the attention of growers to flax. The nnion is expressed that it would be one of the most profitable crops if e fiber could be sold. Reports indicate an increase of area in 1885 in 'isconsin, Minnesota, Iowa, Nebraska, and Dakota. The Calcutta ed is sown in Oregon. It produces short straw and large seed.

FARM ANIMALS.

NUMBERS.

The returns (January, 1886) of the number of horses indicate an in- in horse-breeding of late, which is due to the steady demand for ıı ıle animals for draft purposes and for the farm and road. A uaı improvement is noted by the introduction of famous breeds of ɔı ı draft horses, especially the Norman and Percheron, and to a ıle extent the English Shire horse and the Clydesdale. There ne of new blood in thoroughbred racing or in trotting stock. evic ı that the every-day working horse of America is to be a ıı stronger animal than has been seen heretofore, and that p n of horses may in the future conduce to the stability of

prices and the profit of breeding. Already there is a small export trade in horses. The movement may be slow for some time, and, like that of most products of agriculture, should only be depended on as an outlet for a small surplus; a regulator but never a controller of values.

Almost every State makes some increase. Most of the Atlantic S show an increase of about 1 per cent., as well as Louisiana, Texas, and nois; New York and Virginia, 2; and about the same rate in Arka Tennessee, West Virginia, Ohio, Michigan, and Wisconsin. The States of the Missouri Valley, with rapid advances in settlement and pop tion, show a much larger rate; Nebraska, an increase of 10 per cent., and Dakota of 15. There is also a considerable advance on the Pacific coast. There has been a large increase in the Rocky Mountain region, as horse ranches are becoming numerous and profitable. The total increase in the United States, as estimated, aggregates 513,085.

The number of mules has not advanced faster than population, the increase is distributed with some irregularity, being greatest in States and Territories between the Mississippi and the Rocky M ains. The aggregate increase is placed at 80,024.

The number of cows has decreased somewhat in Vermont, New York, and Ohio, on account of low prices of dairy products. Elsewhere th has generally been advance with increase of population, while there been increase more or less marked in the dairy States of the W The West has recently had advantage of the East in favorable lo tance rates of transportation, in refrigerator cars, for the produ their numerous creameries, by which the cost of marketing fresh has been less from Western Iowa than from Northern Ohio and w ern New York. In the South the increase is general, though small. In the aggregate a showing of 330,666 more cows than last year is

A larger rate of increase has prevailed in other cattle, largely in distant Western States and in the Rocky Mountain region. The w ter of 1884–'85 was comparatively favorable for the ranch cattle and the unhoused animals of the farm region, so that numb has creased in those regions. Though prices have been lower, in sy with the general depression in values, there is an abiding faith in future of stock-breeding in this country. The wide range of pu land, the broad prairies of the farms, must be cropped, and when prices of farm labor are high in comparison with products, stock-farming is ever preferable to arable culture and the results more profitable. The narrowing of the margin of profit in meat-making in recent years is teaching a necessary and valuable lesson that waste must be avoided, animals kept constantly growing, and meat produced in shorter time. There is real progress, slow perhaps, in the economy of meat production, an improvement forced by necessity, as is the greater part of all agricultural progress.

Coming to sheep, it must be observed that sheep husbandry is in a period of deeper depression than any other animal industry of the country. The results of this inquiry manifest a loss of about 2,000,000 sheep. The industry has been peculiarly susceptible to adverse influences, feeling keenly any depression of prices of wool. Values of both wool and mutton have been low, and flocks have been slaughtered in the farm States, or sent West to cheaper pasturage. It is estimated that Pennsylvania has lost in one year a fifth of her flocks, or nearly 300,000 sheep. The loss is the more serious, as it falls mainly on a region peculiarly adapted by its grasses and irregularities of surface for sheep farming, which has long stood in the forefront of improvement in wool growing. The decline is almost universal east of the Mississippi.

rine there has been a small increase in the record, due rather to r enumeration of the stock of the rapidly developing regions of uri Valley than to actual increase. In most of the older States noticed a small reduction; for two years past the supply *per* is less than formerly. The reduction in values, to which the off in exports contributes, tends somewhat to this decline in rs.

aggregate number of farm animals, compared with last year, is own:

Stock.	1885.	1886.	Increase or decrease.
.....	11, 564, 572	12, 077, 657	+513, 085
.....	1, 972, 569	2, 052, 593	+80, 024
s.....	13, 904, 722	14, 235, 388	+330, 666
other cattle	29, 866, 573	31, 275, 242	+1, 408, 669
.....	50, 360, 248	48, 322, 831	−2, 037, 912
.....	45, 142, 657	46, 092, 043	+949, 386

VALUES.

decline in horses, mules, and cattle has been in progress two In sheep and swine it was noticed in the January report of 1884. nt of the reduction is greater in this return than in that of a). It averages only about 3 per cent. in horses and mules. It 8 per cent. in cattle, 11 per cent. in sheep, and 15 per cent. in The comparison with last year is thus shown:

Stock.	1885.	1886.	Decrease.
.....	$73 70	$71 27	$2 43
.....	82 38	79 60	2 78
s.....	29 70	27 40	2 30
other cattle.....	23 02	21 17	1 85
.....	2 14	1 91	23
.....	5 02	4 25	77

year the aggregate decline in total values was small; the pres- luation is $91,266,121 less than last year, notwithstanding in- in numbers of horses and cattle. The grand aggregate is 159,862, against $2,456,425,983 a year ago, showing a reduced ion of nearly 4 per cent. There is a small aggregate gain, how- horses and mules. The reduction in values of milch cows ts to $22,917,570; $32,426,639 in all other cattle; $15,516,783 in and $29,831,789 in swine.

tabular statement is as follows:

Stock.	1885.	1886.	Increase or decrease.
.....	$852, 282, 947	$860, 823, 208	+$8, 540, 261
.....	162, 494, 697	163, 381, 096	+ 886, 399
ws.....	412, 908, 093	389, 985, 523	−22, 917, 570
other cattle	694, 382, 913	661, 956, 274	−32, 426, 639
.....	107, 960, 650	92, 443, 867	−15, 516, 783
.....	226, 401, 683	196, 569, 894	−29, 831, 789
.....	2, 456, 425, 983	2, 365, 159, 863	−91, 266, 121

nbers have increased, except of sheep, in two years past
eg valuation of farm animals is less by something over
It is not improbable, from present indications, that some

improvement in values may occur during the coming year, though great changes in this direction should not be expected. While fluctuations are inevitable, depression followed by elevation, there is some reason to suppose that lower levels of valuation will obtain than in the past two decades.

The following table gives the estimated average prices of fa mi-mals of different classes by age, horses and stock cattle under year, two years and not less than one, and three years old and upwards; while sheep and swine are placed in two divisions, one year being the dividing line.

Table showing the estimated numbers of animals on farms, expressed as a percentage of the numbers of previous years; also average of actual prices in January, 1886.

States and Territories.	Horses.					Mules.					Milch cows.	
	Total number compared with that of January, 1885.	Average price per head.				Total number compared with that of January, 1885.	Average price per head.				Total number compared with that of January, 1885.	Average price per head.
		Under one year old.	Between one and two years.	Between two and three years.	Over three years.		Under one year old.	Between one and two years.	Between two and three years.	Over three years.		
	P. c.					P. c.					P. c.	
Maine	101	$21 00	$32 65	$73 50	$106 50	....	.....	.....	.....	.....	....	.....
New Hampshire	100	20 33	48 50	69 67	98 33	....	.....	.....	.....	.....	....	.....
Vermont	102	30 48	48 63	70 75	108 75	....	.....	.....	.....	.....	....	.....
Massachusetts	101	39 25	63 50	84 00	111 00	....	.....	.....	.....	.....	....	.....
Rhode Island	101	39 00	62 00	89 00	110 00	....	.....	.....	.....	.....	....	.....
Connecticut	101	36 58	60 08	84 17	110 50	....	.....	.....	.....	.....	....	.....
New York	102	34 03	50 93	85 28	110 07	100	$32 87	$50 67	$83 33	$120 50	....	.....
New Jersey	101	41 00	70 09	92 00	118 17	101	52 75	80 00	98 71	124 00	....	.....
Pennsylvania	100.5	38 72	62 88	90 27	117 33	99	46 81	70 42	95 00	123 79	....	.....
Delaware	101	35 00	62 50	83 50	115 00	101	37 00	53 00	83 00	120 00	....	.....
Maryland	101	33 00	50 65	79 45	102 55	102	42 55	63 55	89 50	123 00	....	.....
Virginia	102	28 41	43 96	67 59	86 47	100	33 78	52 51	79 42	101 11	....	.....
North Carolina	101	30 21	47 43	68 86	87 15	101	34 77	53 27	76 23	....	....	.....
South Carolina	101	33 08	53 46	78 54	97 39	101	35 25	61 67	89 58	1...	....	.....
Georgia	101	30 91	47 26	70 72	90 52	100	34 30	52 33	83 04	1...	....	.....
Florida	103	25 91	40 30	64 55	90 46	100	30 50	46 25	77 00	1	....	.....
Alabama	102	25 51	40 35	59 93	85 25	101	30 02	46 53	70 53	....	....	.....
Mississippi	102	25 71	38 96	58 36	80 86	102	33 63	50 17	71 66	99	....	.....
Louisiana	101	16 37	25 82	38 45	73 00	104	23 14	42 86	70 70	8...	....	.....
Texas	101	12 90	18 96	28 12	50 71	105	24 25	35 33	51 12	....	....	.....
Arkansas	102	21 10	33 45	45 52	66 28	105	27 24	46 68	62 66	....	12	....
Tennessee	102	32 33	50 79	68 62	81 63	102	29 22	57 78	79 68	99	11	....
West Virginia	103	25 85	43 56	64 81	80 80	101	31 12	50 65	77 40	....	....	.....
Kentucky	103	32 47	48 20	64 62	80 20	101	38 53	57 17	76 42	....	....	.....
Ohio	102	35 05	55 47	79 30	100 80	110	36 23	56 09	81 61	....	81	....
Michigan	102	34 83	54 06	80 86	104 83	101	35 00	57 00	82 00	....	....	.....
Indiana	103	36 08	55 63	76 98	93 89	101	38 32	60 75	81 75	102	....	.....
Illinois	101	36 39	56 13	76 80	95 11	99	39 00	59 41	80 89	103	49	....
Wisconsin	102	32 59	50 59	73 16	96 06	99	31 24	50 00	74 29	105	87	....
Minnesota	105	32 05	51 26	74 08	90 47	102	34 03	55 15	79 88	110	39	....
Iowa	103	32 68	51 71	71 37	89 79	99	28 11	56 90	78 65	103	10	....
Missouri	103	28 56	41 90	57 72	76 42	103	37 19	52 55	71 20	93	72	....
Kansas	103	29 25	43 58	62 43	85 73	105	37 05	55 59	78 58	105	88	....
Nebraska	110	31 05	50 15	70 50	95 25	105	38 60	60 40	84 55	108	28	....
California	104	22 47	38 68	54 69	86 11	100	29 29	50 13	68 33	98	....	.....
Oregon	107	21 67	35 00	48 11	75 00	102	26 00	43 67	60 67	85	....	.....
Nevada	104	22 50	38 33	53 33	82 67	100	26 67	50 00	71 67	1...	20	....
Colorado	110	20 00	32 75	46 50	75 00	100	25 00	37 00	61 67	....	17	....
Arizona	110	18 00	23 50	36 70	55 00	110	23 00	34 00	58 00	....	....	.....
Dakota	115	32 44	50 42	75 08	100 64	120	37 78	56 58	85 81	1...	....	.....
Idaho	112	23 50	35 00	52 50	77 00	114	28 00	56 00	80 00	....	....	.....
Montana	115	25 00	37 50	52 75	80 00	120	33 00	55 00	83 00	....	08	....
New Mexico	110	14 00	21 50	35 00	53 00	102	21 00	33 00	40 00	65	08	....
Utah	102	23 14	34 80	49 00	69 57	105	24 83	37 00	60 33	81	92	....
Washington	111	28 50	40 00	57 30	92 20	105	27 00	47 50	83 67	1...	....	.....
Wyoming	112	21 00	33 00	42 00	78 00	125	40 00	38 00	63 00	....	....	.....

The following tables give numbers, average price, and aggreg values of farm animals by States:

Table showing the estimated numbers of animals on farms, total value of each kind, average price, January 1, 1886.

States and Territories.	Horses.			Mules.		
	Number	Average price.	Value.	Number.	Average price.	Va
Maine	90,228	$88 30	$7,972,453			
New Hampshire	49,138	82 91	4,074,211			
Vermont	79,202	83 68	6,627,271			
Massachusetts	62,663	103 15	6,463,534			
Rhode Island	9,905	102 58	1,016,071			
Connecticut	47,934	99 66	4,777,165			
New York	647,845	93 22	60,389,110	5,107	$107 33	$5
New Jersey	90,741	103 54	9,395,110	9,407	119 47	1,1
Pennsylvania	577,531	94 10	54,340,474	23,670	109 99	2,6
Delaware	22,330	97 29	2,172,384	4,061	113 74	4
Maryland	126,496	81 62	10,324,641	13,226	108 17	1
Virginia	223,871	69 56	16,267,609	34,342	85 53	2
North Carolina	142,579	74 53	10,625,894	66,452	83 19	5
South Carolina	62,789	86 97	5,398,481	71,119	99 30	7
Georgia	106,884	81 56	8,716,984	143,843	96 50	
Florida	29,419	79 78	2,347,183	11,558	97 21	
Alabama	123,342	70 79	8,731,643	332,948	84 09	11,1
Mississippi	125,154	69 43	8,688,875	147,512	88 57	13,0
Louisiana	112,075	56 41	6,322,937	78,563	95 24	6,8
Texas	998,862	35 89	35,851,466	175,515	54 50	9,5
Arkansas	169,625	54 58	9,258,528	114,317	69 77	7,9
Tennessee	288,604	65 72	18,966,758	187,208	99 69	18
West Virginia	131,621	60 85	8,008,848	6,412	75 50	
Kentucky	383,034	63 09	24,394,384	124,165	99 28	1
Ohio	753,680	79 16	59,659,185	22,999	87 68	1
Michigan	428,650	83 58	35,826,292	5,775	99 60	
Indiana	635,382	75 47	47,960,708	54,943	81 97	4
Illinois	1,048,759	75 21	78,872,127	124,473	82 48	10
Wisconsin	390,700	78 04	30,957,052	8,910	91 51	
Minnesota	334,588	80 00	26,767,040	10,588	96 14	1,0
Iowa	945,445	72 18	68,245,536	48,537	86 09	4,1
Missouri	737,208	58 62	43,198,118	212,615	67 76	14,4
Kansas	549,406	69 98	38,446,250	79,615	89 64	7,1
Nebraska	341,419	74 50	25,435,716	28,827	94 48	2,7
California	275,534	64 00	17,377,542	31,551	77 65	2,4
Oregon	159,786	52 57	8,399,155	3,005	64 41	1
Nevada	42,126	61 13	2,574,968	1,563	80 91	
Colorado	108,570	59 09	6,415,942	7,560	80 33	
Arizona	9,681	58 00	513,093	1,242	94 50	
Dakota	206,388	77 86	16,009,117	11,615	100 40	1
Idaho	44,818	60 00	2,689,080	2,362	87 00	
Montana	120,750	62 68	7,568,028	6,960	84 15	
New Mexico	19,796	39 27	779,288	10,996	54 60	
Utah	52,464	48 52	2,440,808	2,409	62 94	
Washington	81,945	67 45	5,526,821	1,009	85 00	
Wyoming	72,000	53 13	3,825,360	3,100		
Total	12,077,657	71 27	860,923,208	2,052,563	79 60	

States and Territories.	Milch cows.			Oxen and other cattle.		
	Number	Average price	Value.	Number.	Average price.	Va
Maine	165,353	$30 10	$4,977,125	187,030	$29 89	$5
New Hampshire	97,070	29 83	2,895,598	136,169	31 22	4,2
Vermont	218,040	28 63	6,258,252	176,808	26 06	4
Massachusetts	109,968	32 40	3,560,963	108,382	31 67	3
Rhode Island	22,543	34 00	766,462	13,024	36 89	
Connecticut	123,426	32 92	4,063,184	106,724	33 61	3
New York	1,510,300	29 60	44,704,880	868,409	32 06	27
New Jersey	171,214	34 36	5,882,913	69,248	34 65	2
Pennsylvania	902,127	30 10	27,154,023	858,474	27 36	
Delaware	28,390	28 50	809,372	26,605	28 53	
Maryland	131,003	30 15	3,951,549	138,196	25 09	3,4
Virginia	247,807	21 81	5,404,671	423,803	18 42	7
North Carolina	238,955	16 65	3,978,901	423,619	19 26	8

ble showing the estimated numbers of animals on farms, &c.—Continued.

and Territories.	Milch cows.			Oxen and other cattle.		
	Number.	Average price.	Value.	Number.	Average price.	Value.
lina	143,315	$19 93	$2,856,268	214,711	$11 18	$2,400,020
	341,013	18 85	6,257,589	610,811	9 91	6,033,141
	47,915	16 00	766,640	565,600	8 79	4,970,500
	285,290	15 92	4,541,817	432,090	10 15	4,384,375
	277,528	15 98	4,429,267	420,457	9 89	4,158,872
	153,319	19 00	2,912,947	252,863	11 93	3,016,048
	700,876	20 29	14,220,774	4,023,177	13 00	52,298,987
	276,104	17 98	4,964,350	442,173	11 23	4,979,796
	320,417	20 00	6,528,340	475,400	13 43	6,386,604
nia	100,252	25 42	4,226,126	289,519	18 05	5,226,327
	307,767	28 53	8,780,593	529,071	21 18	11,208,055
	775,724	30 58	23,682,854	1,017,820	20 04	27,414,990
	420,982	30 38	12,770,598	506,644	25 52	12,929,152
	540,624	30 00	16,219,020	885,665	25 42	22,514,070
	928,194	31 97	29,303,685	1,485,903	26 04	38,690,737
	565,177	28 63	16,181,018	710,053	23 22	16,489,066
	386,366	27 87	10,768,029	448,695	22 51	10,095,260
	1,230,695	28 80	35,444,016	2,074,919	24 30	50,382,980
	708,098	24 59	17,426,884	1,387,818	20 84	28,921,584
	655,895	28 46	16,307,204	1,494,259	22 94	34,273,005
	409,106	30 80	9,520,465	1,535,457	24 69	37,916,599
	236,378	38 75	9,159,648	627,907	28 66	17,994,559
	42,342	27 46	1,966,511	600,635	23 73	14,397,777
	16,841	39 00	656,799	288,235	23 55	6,788,320
	51,155	40 67	2,080,474	1,019,779	25 85	26,211,893
	13,847	31 00	429,257	238,931	20 00	4,778,620
	181,345	35 94	5,610,814	629,145	23 01	14,750,060
	22,271	35 00	779,485	200,131	22 00	6,382,882
	25,300	37 00	936,100	725,700	22 08	16,023,456
	17,932	26 00	466,232	1,151,857	18 09	20,733,426
	42,013	30 86	1,296,521	162,846	23 88	3,888,586
	56,750	32 00	1,815,360	286,358	26 00	7,445,308
	6,255	38 00	236,854	1,380,916	25 00	32,022,900
				627,000	22 00	13,794,000
	14,235,388	27 40	389,985,623	31,275,242	31 17	951,256,274

and Territories	Sheep.			Hogs.		
	Number.	Average price.	Value.	Number.	Average price.	Value.
	547,407	$2 15	$1,150,771	70,702	$8 78	$620,760
shire	195,200	2 45	478,387	54,404	9 33	507,725
	678,174	2 86	1,082,031	74,115	6 90	511,113
nia	64,561	3 04	196,104	77,610	10 04	779,577
d	28,449	3 75	70,684	14,395	9 80	141,071
	53,477	3 25	173,575	81,782	8 24	509,813
	1,595,824	3 06	4,875,243	722,060	7 53	5,437,448
	107,413	3 76	403,851	193,795	8 35	1,618,574
del	1,169,481	2 68	3,107,809	1,103,391	7 47	8,241,556
	22,294	2 80	62,368	44,431	6 10	271,028
	166,582	3 06	519,739	299,868	5 85	1,785,115
	463,127	2 24	1,035,922	875,256	3 66	3,206,063
lina	468,816	1 28	600,084	1,340,558	3 24	4,357,460
lina	112,935	1 72	194,250	507,181	3 40	1,927,962
	509,594	1 40	730,869	1,585,078	3 15	4,990,952
	91,094	1 65	150,305	298,108	2 38	709,498
	337,047	1 40	471,866	1,351,152	3 15	4,261,533
	276,103	1 50	413,878	1,212,144	3 04	3,685,645
	116,385	1 65	192,466	580,590	3 10	1,800,449
	6,802,615	1 70	11,582,812	2,411,727	2 76	6,656,367
	234,021	1 57	367,891	1,692,365	2 48	4,197,065
	602,780	1 60	967,255	2,122,646	3 20	6,788,232
nia	624,912	1 88	1,174,210	416,133	3 66	1,522,133
	903,223	2 24	2,024,665	2,032,138	3 48	7,068,996
	4,753,034	2 09	9,918,156	2,442,457	4 80	11,720,854
	2,269,607	2 11	4,788,871	840,682	5 27	4,430,293
	1,088,517	2 10	2,288,607	2,773,199	4 66	12,936,420
	1,005,653	2 19	2,205,196	3,967,961	4 70	18,667,017
	1,216,800	1 89	2,305,969	1,056,265	5 18	5,466,282
	278,162	2 21	615,294	440,540	4 67	2,056,000
	467,580	2 28	1,067,204	4,849,008	5 07	24,586,107

Table showing the estimated numbers of animals on farms, &c.—Continued.

States and Territories.	Sheep.			Hogs.		
	Number.	Average price.	Value.	Number.	Average price.	Value.
Missouri	1,285,078	$1 48	$1,908,340	4,168,091	$3 46	$14,404,922
Kansas	1,190,163	1 60	1,898,667	2,275,178	4 86	11,050,[illegible]
Nebraska	448,678	2 15	965,993	2,312,784	5 08	11,748,[illegible]
California	6,060,698	1 81	10,961,268	1,027,598	4 15	4,[illegible]
Oregon	2,469,551	1 47	3,618,139	191,600	2 81	[illegible]
Nevada	661,261	1 73	1,145,436	14,399	4 55	65,[illegible]
Colorado	1,126,645	1 77	1,994,162	17,032	7 38	125,[illegible]
Arizona	806,002	1 70	1,523,203	10,149	4 50	45,[illegible]
Dakota	253,672	2 24	568,226	355,980	4 98	1,773,[illegible]
Idaho	210,375	2 10	441,788	26,762	5 60	149,[illegible]
Montana	718,750	2 12	1,523,391	19,298	6 26	[illegible]
New Mexico	4,328,755	1 60	6,934,066	17,492	5 55	97,[illegible]
Utah	651,767	2 08	1,356,568	27,554	7 16	197,[illegible]
Washington	544,548	2 25	1,223,491	66,779	4 81	[illegible]
Wyoming	518,466	2 07	1,072,188	2,500	6 50	16,[illegible]
Total	48,322,331	1 91	92,448,867	46,092,043	4 25	196,[illegible]

VALUES OF PEDIGREE STOCK.

Consultation with herd-book officials results in the following estimates of valuation of the breeds named, the short horn and certain other organizations not reporting:

Breed.	Number registered.	Number living.	Average value.	Total value.
Aberdeen-Angus	.....	3,500	[illegible]	[illegible]
Ayrshire	12,867	6,433	100	[illegible]
Devon	10,157	8,000	81	[illegible]
Guernsey	4,947	3,100	149	[illegible]
Hereford	.....	14,000	300	[illegible]
Holstein-Friesian	21,138	20,061	200	[illegible]
Jersey	51,000	.....	.....	.....

LIVE STOCK IN FOREIGN COUNTRIES.

Of the statistics given below, those for the principal European countries (excepting Russia and Spain), and also those for the British colonies, are obtained from official documents. The remainder are drawn from a variety of sources, including reports of American and British consuls to their respective Governments and such statistical handbooks as the *Statesman's Year Book*, Mulhall's *Dictionary of Statistics*, and Dr. von Neumann-Spallart's *Uebersichten der Weltwirthschaft*.

Cattle and horses.

Countries.	Years.	Cattle.			Horses.
		Cows.	Other kinds.	Total.	
EUROPE.					
Austria	1880	4,138,625	4,445,452	8,584,077	[illegible]
Hungary	1880	1,740,399	2,857,144	4,597,543	[illegible]
Do	1883	.....	.....	.....	[illegible]
Belgium	1880	796,178	586,637	1,382,815	[illegible]
Denmark	1881	898,790	571,288	1,470,078	[illegible]
France	1881	7,290,827	4,285,363	11,576,190	[illegible]
Germany	1883	9,086,906	6,698,416	15,785,322	[illegible]
Great Britain	[illegible]	2,530,197	4,067,767	6,597,964	[illegible]
Ireland	1885	1,417,481	2,811,270	4,228,751	[illegible]
Isle of Man, &c	1885	17,834	24,211	42,045	[illegible]

* The statement as to horses for France includes only horses employed on farms.

Cattle and horses—Continued.

Countries.	Years.	Cattle.			Horses.
		Cows.	Other kinds.	Total.	
UROPE—Continued.					
	1877			279,445	97 170
	b1881	2,308,556	2,416,676	4,788,232	b680,129
	1882	878,956	548,980	1,427,936	270,456
	1883			1,437,055	259,182
	1870			624,658	
	1880			d 3,600,000	600,000
	1882			23,845,104	20,015,659
	1882			826,550	122,500
	1878			2,363,247	
	1883	1,456,504	830,509	2,287,013	472,787
	1875	741,398	275,019	1,016,617	151,909
	1876			1,035,930	
RITISH COLONIES.					
				2,732,600	864,150
	1881				
ia	1881			325,603	57,167
swick	1881			212,560	52,976
ward Island	1881			60,281	16,739
lumbia	1881			90,722	31,335
tories	1881			80,451	20,122
	1881			12,872	10,870
a Wales	1884			1,396,329	330,662
	1884			1,262,538	291,006
straha	1884			389,720	168,420
tralia	1884			71,102	37,111
	1884			128,834	27,188
nd	1881			698,637	161,736
d	1884			4,266,172	253,116
colonies:					
land	1875			13,939	4,057
	1883			84,206	45,969
	1884			963,896	8,683
	1884			15,000	12,000
Islands	1884			11,569	2,770
ood Hope	1875			1,329,445	241,342
	1884			575,698	48,431
FRENCH COLONIES.					
	1880			1,163,513	360,000
	1880f			9,615	5,968
orea	1883			3,000	1,000
SOUTH AMERICA.					
public	1883			12,000,000	4,800,000
	1882			811,000	68,000
				500,000	
	1883			6,010,000	513,000
THER COUNTRIES.					
	1884g			400,000	
tate	1881			464,575	131,694
	1880			1,124,564	1,026,543

of Thessaly, which now forms part of the Kingdom. The number of oxen in Thessaly ated at 200,000.
e as to horses in Italy are for 1882.
next table.
a his *Dictionary of Statistics* gives this as the number of cows, but it should probably en as the number of cattle in general, as in 1873 these were estimated to reach a total of

ding Poland.
le had 1,976,480 cattle and 558,809 horses.
oba had 64,011 cattle and 20,071 horses.
ly.
782 cattle and 35,357 horses in Basuto Land.
e at hand for French colonies other than the three given above.
its dependencies. The figures are taken from a report by United States Consul Department of State in October, 1880, and may perhaps be regarded as referring though it is not explicitly so stated.

Other domestic animals.

Countries.	Year.	Mules.	Asses.	Sheep and lambs.	Swine.	Goats.
EUROPE.						
Austria	1880	*a*12,710	36,908	3,841,340	2,721,541	1,006,65
Hungary	1880	.....	.....	9,232,123	.....	236,35
Belgium	1880	*b*10,120	(*b*)	365,400	646,375	24
Denmark	1881	.....	282	1,548,613	527,417	
France	1881	273,870	388,704	22,301,504	5,638,884	1
Germany	1883	1,009	8,786	19,185,362	9,205,791	1
Great Britain	1885	.....	.....	26,584,635	2,403,380	.....
Ireland	1885	.....	.....	8,477,840	1,269,122	.....
Isle-of-Man	1885	.....	.....	73,725	14,126	.....
Greece *c*	*d*1877	45,176	97,395	2,921,917	*d*179,002	1,836,62
Italy	*e*1881	*e*293,868	674,246	8,596,108	1,163,916	2,616,87
Netherlands	1883	.....	.....	703,521	420,618	15
Portugal *f*	1870?	.....	.....	2,977,454	971,085	39
Roumania	1880	.....	.....	6,180,000	2,310,000	.....
Russia in Europe *g*	1882	.....	.....	47,508,966	9,207,666	1
Servia	1882	.....	.....	3,620,750	1,067,940	
Spain	1878	941,653	890,982	16,939,288	2,348,602	1
Sweden	1883	.....	.....	1,412,494	454,708	
Norway	1875	.....	.....	1,686,306	101,020	
Switzerland	1876	.....	.....	367,549	334,515	39
BRITISH COLONIES.						
Canada:						
Ontario *h*	1881	}	.....	2,249,011	1,030,121	.....
Quebec	1881					
Nova Scotia	1881	.....	.....	377,801	47,256	.....
New Brunswick	1881	.....	.....	221,163	53,087	.....
Manitoba *i*	1881	.....	.....	6,073	17,358	.....
Prince Edward Island	1881	.....	.....	166,496	40,181	.....
British Columbia	1881	.....	.....	27,788	16,841	.....
The Territories	1881	.....	.....	346	2,775	.....
Australasia:						
New South Wales	1884	.....	.....	30,879,871	211,656	.....
Victoria	1884	.....	.....	10,020,173	281,558	.....
South Australia	1884	.....	.....	6,696,406	168,807	.....
West Australia	1884	.....	.....	1,547,061	20,039	.....
Tasmania	1884	.....	.....	1,720,027	57,303	.....
New Zealand	1881	.....	.....	13,384,075	200,068	.....
	1884	.....	.....	14,056,266	.....	.....
Queensland	1884	.....	.....	9,308,911	51,796	.....
Other British colonies:						
Newfoundland *k*	1869	.....	.....	23,044	6,417	.....
Jamaica	1869	.....	.....	21,761	9,066	.....
Ceylon	1884	.....	.....	53,757	.....	.....
Mauritius *l*	1884	.....	.....	30,000	30,000	.....
Falkland Islands	1884	.....	.....	473,227	.....	.....
Cape of Good Hope *m*	1875	.....	.....	11,279,743	132,373	.....
Natal	1884	.....	.....	560,632	25,848	(*n*)
FRENCH COLONIES. *o*						
Algeria	1880	.....	.....	6,992,218	300,000	1
Guadeloupe *p*	1880	5,127	2,492	13,690	14,116	
Tahiti and Moorea	1883	15	.....	3,000	20,000	
SOUTH AMERICA.						
Argentine Republic	1883	200,000	400,000	68,000,000	250,000	1
Chili	1882	.....	.....	*q* 1,000,000	100,000	
Uruguay	1883	.....	.....	14,545,000	100,000	.....
OTHER COUNTRIES.						
Orange Free States	1881	.....	.....	5,056,301	.....	

a Hinnies included with mules.

b Asses and hinnies are included with mules.

c Thessaly, which has become a part of the Greek Kingdom since 1877, is not included in these figures. The number of sheep in Thessaly has been estimated at 1,500,000 and the number of goats at 1,000,000.

d The figures as to swine are for 1875.

e The figures as to mules are for 1876.

f The figures as to Portugal are taken from Dr. von Neumann-Spallart's *Uebersichten der Weltwirthschaft*, where the date is marked with an interrogation point, as in the above tables. The figures as to sheep here given for Portugal and those as to cattle for the same country, as given on the preceding page, are identical with the figures given in the *Statesman's Year Book* as for 1882.

g Not including Poland.

h In 1885 Ontario had 1,755,605 sheep and 822,262 swine.

i In 1884 Manitoba had 6,431 sheep and 44,901 swine.

k In 1875 Newfoundland had 28,766 sheep.

l Approximate.

m Including 303,080 sheep and 15,635 swine in Basuto Land.

n According to the *Statesman's Year Book* for 1884, there were in Natal in 1881 70,000 Angora goats owned by European residents.

o See note *k* on preceding page.

p See note *l* on preceding page.

q Goats are included with sheep.

INTERNATIONAL DAIRY STATISTICS.

›omparison of dairy products of this and foreign countries, the nce, not to say profusion, of the supply of the United States of d its products is clearly manifested. This country consumes 17 of butter per capita, not to mention a pound or so of oleomarga- ıile Europe is said to use only 5 pounds per head. There is little ıity in the rate of consumption, however, of different countries. ımed average in Great Britain is 13 pounds, 8 in Germany, 6 ınd and Belgium, 4 in France, 2 in Russia, and 1 in Italy. Our › is apparently increasing.

›roduction of milk from all cows, whether on farms or in towns ges, from about 16,000,000 animals kept for milk, is assumed to › 350 gallons each per annum, or 98 gallons per capita of popu- The aggregate production on this basis is 5,600,000,000 gallons, h 3,000,000,000 gallons (in round numbers) are required to make)0,000 pounds of butter, and 430,000,000 to make 370,000,000 of cheese, leaving 2,170,000,000 gallons for use as food in its state. The State averages of product per cow vary widely, from lons per annum in some of the dairy States down to 150 gallons : of the extreme Southern States, where little attention is given l or feed, or the production of butter or cheese.

'ollowing table gives the exports of the past ten years, both of ınd cheese, quantity and value:

nded June 30—	Exports of—				
	Butter.		Cheese.		Total butter and cheese.
	Quantities.	Values.	Quantities.	Values.	Values.
.....	4,644,894	$1,109,496	97,676,264	$12,270,088	13,379,579
.....	21,527,242	4,424,016	107,364,066	12,700,627	17,125,243
.....	21,837,117	3,931,822	123,783,736	14,103,529	18,035,351
.....	38,248,016	5,421,205	141,654,474	12,579,968	18,001,173
.....	39,236,658	6,690,687	127,353,907	12,171,720	18,862,407
.....	31,560,500	6,256,024	147,995,614	16,380,248	22,636,272
.....	14,794,305	2,864,570	127,989,782	14,058,975	16,923,545
.....	12,348,641	2,290,665	99,220,467	11,134,526	13,425,191
.....	20,627,374	3,750,771	112,860,575	11,663,713	15,414,484
.....	21,683,148	3,643,646	111,992,990	10,444,409	14,088,055
d	226,507,895	40,383,502	1,198,101,475	127,507,798	167,891,300
.....	22,656,790	4,038,350	119,810,148	12,750,780	16,789,130

›utter, 98 per cent. of it at least, is eaten at home. The lower only are included in the exports. Half of the product of 1885 ıuffice to replace the exports of the last sixty-five years. In 1821 as an export of 1,000,000 pounds, and this annual export was not ed more than 50 per cent. in the next fifteen years. From 1835 the annual export dropped to less than half a million pounds. the shipments increased, and were rarely less than 2,000,000 or)0 pounds or more than 4,000,000, until 1860, after which, during ›rs of high gold premiums, the trade reached about 20,000,000, ıgain, from 1866 to 1876, to figures varying from 1,000,000 or)0 to 6,000,000 pounds.

ports of cheese are more important, and for ten years have d 26 per cent. of the production. The average annual exports period are 119,810,148 pounds, valued at $12,750,780, or 10.6 · pound. The average annual value of exports of butter and : ten years, is $16,789,130.

Table showing the average annual imports and exports of butter and cheese, and value of the same, for European and other countries named.

Countries.	Butter.							Cheese.						
	Imports.				Exports.			Imports.				Exports.		
	Period for average (inclusive).	Pounds.	Price per pound.	Value.	Pounds.	Price per pound.	Value.	Period for average (inclusive).	Pounds.	Price per pound.	Value.	Pounds.	Price per pound	Value.
			Cents.			Cents				Cents.			Cents.	
Canada	1875–'84	.....	.....	.....	13, 105, 318	20	$2, 582, 132	1875–'84	.....	.....	.....	45, 509, 303	10	$4, 778, 243
Austria-Hungary	1878–'83	287, 002	16	$46, 243	13, 981, 242	13	1, 866, 881	1874–'83	3, 566, 046	13	$463, 190	2, 250, 359	10	233, 796
Belgium	1874–'83	13, 970, 230	27	3, 832, 169	10, 116, 468	27	2, 772, 406	1874–'83	8, 337, 797	13	1, 004, 850	328, 880	13	43, 174
Denmark	1874–'83	5, 952, 194	23	1, 357, 573	30, 170, 494	25	7 459, 481	1874–'83	1, 368, 289	17	227, 105	143, 244	6	8, 361
France	1874–'83	11, 850, 166	25	2, 958, 690	76, 585, 379	23	17, 452, 370	1874–'83	41, 846, 615	10	4, 384, 310	8, 789, 520	14	1, 240, 990
Germany*	1884–'83	16, 807, 319	21	3, 523, 828	27, 266, 493	21	5, 824, 336	.....	.....	.....	.....	.....	.....	.....
United Kingdom	1874–'83	213, 968, 440	28	50, 260, 822	3, 952, 838	28	1, 107, 371	1874–'83	102, 271, 867	12	22, 848, 312	1, 784, 854	18	319, 679
	1879–'83				5, 732, 518	21	1, 211, 330	1879–'83				4, 830, 461	14	687, 009
Italy (for home consumption)	.....	.....	.....	.....	.....	.....	.....	1874–'83	17, 075, 078	17	2, 931, 516	.....	.....	.....
Netherlands	1874–'83	2, 363, 111	15	344, 715	68, 074, 234	14	9, 430, 445	1878–'82	441, 557	6	28, 160	61, 374, 190	6	3, 916. 967
Portugal	1872–'81	2, 500, 391	25	616, 664	3, 872	20	764	1872–'81	708, 338	16	113, 422	38, 047	13	5, 209
Russia in Europe	1873–'82	.....	.....	.....	6, 253, 027	16	1, 017, 083	.....	.....	.....	.....	.....	.....	.....
Sweden	1874–'83	.....	.....	.....	10, 219, 378	25	2, 524, 422	.....	.....	.....	.....	.....	.....	.....
Norway	1876–'83	7, 444, 727	20	1, 471, 819	1, 897, 373	18	336, 792	1876–'83	689, 687	13	92, 409	.....	.....	.....
Switzerland	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Newfoundland	1874–'83	2, 123, 509	17	362, 836	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Jamaica	1874–'83	554, 696	20	142, 103	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Barbadoes	1874–'83	781, 028	24	190, 043	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
British Guiana	1874–'83	592, 684	22	131, 699	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Victoria	1874–'83	142, 688	23	33, 398	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Tasmania	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Natal	1878–'83	.....	.....	.....	40, 477	18	7, 330	.....	.....	.....	.....	.....	.....	.....

* Figures for 1880 and 1881 not given in documents at hand.

e at this table will show why there is not an unlimited de-
surplus dairy products abroad. While all countries report
, in a small way usually, the only European countries in this
return net imports of butter are the United Kingdom, Nor-
ium, Portugal, and of these only the former receives any con-
amount. Cheese is received by Great Britain, France, Italy,
Denmark, and Austria, mostly by Great Britain, as in the case
In short, already 99 per cent. of the butter supply of Europe
Europe, and 86 per cent. of the cheese.

FOREIGN CUSTOMS IMPORTS.

opean agent of the Department, Edmund J. Moffat, esq., dep-
-general at London, furnished, in the spring of 1885, a state-
ie tariff rates of principal European countries upon certain
mported from the United States, which was published in the
t. Changes have since occurred in some of the rates of France,
Switzerland, and Russia, which render necessary a publica-
ne of the more important rates, which are given as follows:

Import duties.—Foreign countries.

Articles.	Austria-Hungary.	France.	Germany.	Italy.
..... per head..	$4 07	$4 82.5	$7 14	$3 60
.....do....	1 63	2 31.6	.....	3 60
.....do....	1 22	2 31.6	2 14.2	1 50
le .....do....	81	1 54.4	1 42.8	1 20
..... do ...	41	77.2	71.4	60
.....do....	20	57.9	23.8	04
.....do....	20	19.3	Free.	.....
.....do....	10	19.3	11.9	.....
.....do....	10	19.3	.....	.....
.....do....	1 21	1 15.8	1 42.8	50
.....do....	1 21	19.3	23.8	15
.....do....	4 07	.....	4 76	4 00
.....do....	81	.....	2 38	1 20
.....do....	81	.....	2 38	30
ı.....100 kilograms..	10	Free.	23.8	23
.....do....	10	29	71.4	23
.....do....	21	57.9	71.4	28
.....do....	62	1 15.8	1 78.5	56
.....do....	4 07	3 00	4 76	20
.....do....	4 07	2 60 to 3 00	.....	2 00 to 3 00
.....do....	4 07	1 20 to 1 60	4 76	3 00
.....do....	6 61	.....	2 38	.....
.....do....	6 61	.....	.....	.....
.....do....	Free.	Free.	Free.	Free.
.....do....	8 54	(*)	20 23	Prohibited.
ed .....do....	21 36	.....	23 80	.....
.....do....	.....	720 00	64 26	40 00
.....do....	.....	1 35.1	4 76	1 00
.....do....	.....	1 60	.....	.....
noked.....do....	.....	1 64.1	.....	5 00
.....hectoliters..	.....	90	†11 42 to 19 04	‡3 00
ł brandy .....do....	.....	6 00	} †19 04	5 00 to 10 00
rs.....do....	.....	8 00	}	

nt account free; private account prohibited. †100 kilos. ‡In casks.

Import duties.—Foreign countries—Continued.

Articles.	Norway.	Russia.	Spain.	Switzerland.
Animals:				
Oxen ..... per head..	Free.	Free.	$2 76	$0 38 to $0.86
Bulls ..... do....				15
Cows ..... do....			38	10
Young cattle ..... do....				
Calves ..... do....			1 68	20
Sheep ..... do....				10
Goats ..... do....			6 30	30
Lambs ..... do....			3 92	30
Kids ..... do....			1 68	20
Hogs ..... do....				
Pigs ..... do....				
Horses ..... do....				
Mules ..... do....				
Asses ..... do....				
Grains:				
Indian corn ..... 100 kilograms..	$0 05.4	.....	64	85
Rye ..... do....	05.4	.....	64	60
Wheat ..... do....	06	.....	88	60
Flour ..... do....	32.5	*24	1 32	24
Hops ..... do....	12 60	.....	.....	77
Butter ..... do....	.....	*4 20	11 20	50
Cheese ..... do....	4.02	*14 79	7 20	1 15
Lard ..... do....	.....	.....	3 00	20
Cotton ..... do....	.....	*1 10	30	12
Tobacco:				
Leaf ..... do....	33 50	*37 50	.....	.....
Manufactured ..... do....	40 20	†86	.....	.....
Cigars ..... do....	67 00	†2 40	†1 00 to 1 60	.....
Meat:				
Fresh ..... do....	.....	.....	.....	20
Salted or smoked ..... do....	.....	‡4 65.9	56	77
Wines ..... hectoliters..	.....	‡6 15	10 00 to 30 00	.....
Spirits:				
Alchol and brandy ..... do....	.....	‡27 00	4 00	.....
Other liquors ..... do....				

* Cwt. † Pound. ‡ In casks, cwt.

CONCLUSION.

The printed reports of this branch of the Department service, for the year 1885, consist of the Annual Report of the Statistician, eleven serial reports of crop and general statistics, domestic and foreign, and a descriptive catalogue of exhibits of charts and diagrams at the New Orleans Exposition. An investigation of the status of irrigation of the dry areas of the Rocky Mountain system has been in progress and is nearly ready for publication. An agricultural survey of this region is a present necessity; some work has already been done in this direction, and a more general and systematic effort is in contemplation as facilities are afforded. It has already been shown that the resources of this region are not popularly appreciated, and it is evident that future surprises are in reserve for the general public.

J. R. DODGE,
Statistician.

HON. NORMAN J. COLMAN,
Commissioner.

T OF THE CHIEF OF THE BUREAU OF ANIMAL INDUSTRY.

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have the honor to transmit herewith my report, which con-
:atement of the more important work accomplished by the
: Animal Industry during the past year. For many interest-
s connected with this work, and for the reports of the agents
ctors, I must refer you to the Second Annual Report of the
: Animal Industry.

D. E. SALMON, D. V. M.,
Chief of the Bureau of Animal Industry.

ORMAN J. COLMAN,
Commissioner of Agriculture.

)N TAKEN IN REGARD TO PLEURO-PNEUMONIA.

time my last annual report was submitted there was in prog-
e Western States the first outbreak of contagious pleuro-pneu-
ich had ever invaded that section of the country. Although
e seemed to be under control in Ohio and Illinois, there were
sons to fear that some infected herds might have escaped dis-
id there were grave apprehensions that the contagion would
l to spread from the affected herd in Kentucky. The owners
rd assumed an unfriendly attitude towards the officers of the
om the time the first investigations were made, and were so
determined to save themselves from loss without regard to
of their neighbors or that of the country at large as to make
bly certain that the trouble would be disseminated by their
pite of all that could be done under either the national or State
:event it. They employed able counsel to protect their inter-
demanded complete compensation for all loss to which they
subjected in efforts to isolate the contagion, even asking that
f feeding the herd while in quarantine should be assumed by
:u.

pections in the Eastern States had demonstrated the prevalence
ie disease in the vicinity of New York City and Brooklyn, and
f New Jersey, Pennsylvania, Maryland, the District of Colum-
Virginia. The experiments and other investigations were also
in demonstrating beyond question the contagiousness of this
nd its identity in all of its characters with the contagious
eumonia of Europe.

report the history of these outbreaks and the account of our
ions will be resumed at the point where it was necessary to
n last year.

PLEURO-PNEUMONIA IN KENTUCKY.

e was no law among the statutes of Kentucky which had been
lth such an emergency in view as occurred by the introduction

of the malady might before that time work irreparable injury to
tle interests of the State.

On the other hand, Governor Knott contended that the comm
and the general provision of the statutes in regard to distempere
were amply sufficient to accomplish all that could possibly be d
legislation.

The following letter, which I find in the *Home and Farm*, a pap
lished at Louisville, Ky., in its issue of October 15, 1885, gives t
ernor's views so clearly that it is inserted as a document of grea
est at this time:

FRANKFORT, KY., *September 24*

*To the honorable judge of the county court and justices of the court of claims o
County:*

GENTLEMEN: I am this moment in receipt of a copy of your resolution of
instant, calling my attention to the fact that the disease known as pleuro-pn
has made its appearance in an extensive herd of cattle near Cynthiana, in
County, and suggesting in my "experience and intelligence some means might
to avert what threatens to be a most serious calamity, in view of the high
gious character of that malady."

Tendering you my sincerest thanks for such a distinguished indication of
fidence, I have the honor to say that the subject had already excited
interest, and I had, on more than one occasion, expressed to others my w
do anything in my power that might be necessary to prevent the spread o
astrous plague in our State. It is a mistake, however, to suppose "that t
law in existence to meet the gravity of the occasion;" on the contrary, it
that the law is amply adequate to the emergency.

Should the owner of a herd of cattle, known to be infected with pleuro
or any other contagious distemper, keep them in such a situation as woul
to favor the communication of the contagion to others, he would be liable t
ment under the common law for maintaining a nuisance, and, upon con
punishment by fine and imprisonment, in the discretion of the jury, and in
to that judgment the court would have power, if the offense were laid with
uando, to order that the nuisance abate, and the abatement might be enforce
essary, even to the destruction of the property from which the nuisance spri
court would, in such cases, have authority to order the sequestration of
herd until all liability of communicating the contagion had ceased, or its
as the circumstances might indicate to be more advisable.

Even private citizens may, at their own expense, abate a public nu
they would be compelled to answer in damages in case they should
beyond what is actually needed, or the fact should turn out to be i
thorize such peremptory intervention. In view of such responsibil
private citizen of ordinary prudence would think of resorting to such a
cept in the extremest emergency, especially as the courts have power to giv
redress.

In addition to the remedy by penal prosecution, which may result, as I hav
said, not only in the fine and imprisonment of the delinquent own
herd, but the sequestration or destruction of the herd itself, he w
in damages to any one directly injured by the spread of the con

iability under the circumstances, and have assured me that they will use every ıtion to prevent the spread of the disease, and every effort in their power to ex- e it if it really exists among their cattle. What precautionary methods should :en by other cattle dealers and breeders will of course be dictated by their own nce and intelligence. The only suggestion that I can make is that the law l be rigidly enforced wherever the circumstances require it; that, if anything, nsure the extirpation of the disease, as it must result in the destruction of the ed animals themselves, if necessary.

h sentiments of great respect, I am, very truly, your obedient servant,

J. PROCTOR KNOTT.

will be seen that in this communication Governor Knott points out ırse of procedure which, if enforced, would seem to inevitably lead e annihilation of all dangerous cattle in the State. As a matter of it was not enforced. The diseased cattle were handled so recklessly many others were infected; the plague notoriously existed in the of Messrs. Frisbie & Lake for month after month, endangering ıtock of their neighbors and causing burdensome restrictions to be ed upon the cattle trade of the whole State, but no legal measures adopted in accordance with the plan so forcibly outlined by the ırnor. Whether this action was deferred because of the intimation ıe above letter that the parties enforcing this law "would be com- d to answer in damages in case they should resort to violence be- l what is actually needed, or the fact should turn out to be insuffi- to authorize such peremptory intervention," or whether it was use of a general feeling that the measures indicated were not as tical and efficient as the governor thought, is not clear, but it is be- d that both of these reasons had considerable influence.

ıe Department received many letters from citizens of Kentucky ng that the infected cattle were not isolated sufficiently to prevent ıpread of the contagion, that some cows believed to be affected were ved to mingle with other cows belonging to citizens of Cynthiana, asking that an inspector be sent there to watch the course of events to do whatever was possible towards checking the disease, until e efficient and practical legislation could be enacted either by Con- s or the State legislature. In view of the great amount of property atened, and the possibility of violations or evasions of the act of gress prohibiting the movement of affected animals from one State erritory into another, it was deemed advisable to accede to these ıests. Accordingly Dr. H. A. Woodroffe, a gentleman who was well mmended for professional ability, and who had acquitted himself ı credit in the English veterinary service, was appointed December 884, and instructed to proceed at once to Kentucky. He was to con- with the leading stock-owners, to keep a supervision of the cattle ıt Cynthiana, and to inform the Department of any violation of the or of any movement of cattle that there was reason to believe had ı exposed to the contagion.

n Saturday, December 27, 1884, a letter was received at the Depart- ıt from Dr. Woodroffe stating that Messrs. Frisbie & Lake were to make a large shipment of animals from their herd to the State exas, and that he had given them a certificate of health after hav- ı de an examination of them. The Chief of the Bureau was then ıt in New York, where he had gone on official business, but was d in his office on Monday morning. His immediate return was l, however, by serious illness, which prevented any attention to for nearly a week. As a consequence, no action was taken to the shipment of these cattle until Friday, January 2, 1885, at e the Commissioner of Agriculture notified the owners and the

agent of the Kentucky Central Railroad not to move them without a permit from this Department.

This action was taken because, first, in the conference of Kentucky cattle-breeders, held in Lexington, Ky., September 19, 1884, Messrs. Frisbie & Lake, through their counsel, were reported to have made this statement:

> On the 15th instant, they received a letter from Carman, Acting Commissioner of Agriculture, and afterwards from Governor Knott, to make no sales. Wednesday they noticed several cattle sick, and Dr. Hagyard was sent for and slaughtered a cow, and discovered the presence of pleuro-pneumonia. Since then several others have taken sick, and have been in contact with the herd, which numbers upwards of 200 animals.—(*Cincinnati Commercial Gazette*, September 21, 1884.)

Secondly. In a letter to the Department, dated September 18, 1884, Messrs. Frisbie & Lake wrote:

> Our herd consists of about 250 head, and all of them had an opportunity to take the disease if contagious. (First Annual Report of Bureau of Animal Industry, 1884, p. 32.)

Thirdly. On September 24, 1884, the Chief of this Bureau visited the farm of Mr. Lake, of which A. T. Fitzwater was tenant, and upon which a part of these animals were kept, and found there running with the remainder of the cattle on the farm two animals which, on examination of the lungs, presented very plain symptoms of pleuro-pneumonia, and others which were not examined, but which did not appear well, and which were believed at the time to be suffering from the same disease. Mr. Frisbie was present at this examination, and expressed the opinion that a considerable number were more or less affected. Indeed, at the time of this visit no one questioned the fact that the unregistered as well as the registered cattle had been exposed and were sickening, and when the stockmen of the State attempted to raise money to purchase and slaughter this herd they appraised the unregistered as well as the registered, and they did this because of the statement of Messrs. F & Lake that all were infected.

These facts were deemed sufficient to justify the holding of the herd in Kentucky until a longer period had elapsed, even though the inspectors had been unable to find any traces of disease by a careful and thorough examination. The examination actually made, it was learned afterwards, was a very superficial one, less than half of the animals in the herd being caught for this purpose.

January 3, 1885, telegrams were received from Dr. Woodroffe and Frisbie & Lake, stating that the cattle had already been shipped, that they were healthy and for six months had been miles away from the diseased herd. A telegram was immediately sent to the governor of Texas, notifying him of the facts in regard to the shipment of this herd and recommending quarantine and careful supervision of the animals for three months after their arrival.

January 4, Dr. Woodroffe telegraphed that he had received information that Dr. F. B. Hamilton, president of the Jersey Breeders' Association, of Jackson, Tenn., had shipped to that place, by way of Lexington, 24 registered Jersey cows and calves from the infected herd of Frisbie & Lake; also that Frisbie & Lake's shipment to Texas consisted of 125 head of unregistered Jerseys.

Upon the receipt of information that animals undoubtedly affected with pleuro-pneumonia had been taken from the herd of Frisbie & Lake to Tennessee, the governor of that State was at once notified of the fact, and Dr. Hamilton and the railroad agents at Jackson, Tenn., were notified that any shipment of these animals from Tennessee into any other

vould render the shipper liable to the penalty prescribed in the industry law.

rder to learn the condition of the cattle shipped to Texas and to ı such veterinary assistance as might be needed, Dr. Trumbower, ɔector of the Bureau, was ordered to proceed to Austin and keep rvision over the Frisbie & Lake cattle, and to consult with the or as to what measures could be taken to hold them in quarau- ıtil they could be safely sold.

he 9th of January Dr. Woodroffe reported that the shipment to consisted of 125 head of cattle, of which 112 were unregistered nd heifers, and 13 were registered bulls; that they were taken hree different farms near Cynthiana, as follows: 11 cows and (unregistered) from the farm of John Moore, 6 miles from Cyn- ; 51 heifers (unregistered), 3 bulls (registered) from the farm oc- by George Mitchell, 6 miles from Cynthiana; 50 cows and heif- registered), 10 bulls (registered) from the farm occupied by A. water as tenant of J. K. Lake, 3 miles from Cynthiana. None of nimals were sold previous to shipment, and all were sent to Fris- ake, Austin, to be offered for sale there at the expiration of thirty

n explanation of his action in giving a certificate of health, Dr. offe wrote:

time I granted the certificate I was not aware that you and the Commissioner ulture had prohibited the movement of the unregistered cattle, they being lo- different farms, fully 9 miles from where the infected herd was kept. Messrs. & Lake having mentioned to me casually that they were going to ship some ered stock to Texas, I expressed a desire to see them, thinking that as I was pot it was my duty to inspect cattle in the neighborhood before being shipped er State. Messrs. Frisbie & Lake, acting under the advice of their attorney, 'est, at first protested against my inspecting these cattle, stating that they ady been examined and passed by Dr. Hagyard, of Lexington, whom you had :nded to them, making it a Government transaction. Having satisfied me cattle referred to had not been exposed to the infected herd by producing the s of a number of reputable residents in Harrison County, I consented to give :ertificate of health, provided I did not detect any traces of pleuro-pneumonia contagious diseases among them. Mr. Frisbie then drove me out to the dif- rms where the cattle were, about 9 miles from the town, and after a careful tion I found them free from any appearances of disease and gave the owners :ate to that effect, a copy of which I forwarded you with my report the fol- lay, thinking it would reach you before the cattle were shipped. It never my head that there would be any question raised in the matter; otherwise I ave telegraphed at once.

ll be noticed that Dr. Woodroffe states that the unregistered vere from farms located "fully 9 miles from where the infected as kept," and, further on, that Mr. Frisbie accompanied him "to 'erent farms where the cattle were, about 9 miles from the town." rence to an earlier paragraph in the same letter it will be seen ıe of these farms was located but 3 miles from town and the wo but 6 miles. The latter statement is the correct one. It will observed that 60 of the animals shipped were from Mr. Lake's f which A. T. Fitzwater was tenant. This farm was but 3 miles wn, and probably not more than 2 miles from Mr. Lake's home vhere a part of the sick cattle were kept. The attention of the is directed to these incorrect statements to prevent his being as to the actual condition of affairs.

e seems to be little reason to doubt that Dr. Woodroffe was de- by Messrs. Frisbie & Lake as to the relation of Dr. Hagyard to tment of Agriculture. He stated that he was shown a tele-

gram from the Chief of the Bureau of Animal Industry advising the employment of Dr. Hagyard, and supposed that owing to his (Dr. Woodroffe's) absence in Ohio, Dr. Hagyard had been temporarily employed by the Department to make this examination. As a consequence his own inspection was less thorough than it would have been, and he gave a certificate of health which he probably would not have given had he understood that Dr. Hagyard was recommended to Messrs. Frisbie & Lake for an entirely different purpose.

As this telegram was afterwards used by Messrs. Frisbie & Lake in their advertisements and newspaper articles, and, by omitting or some cases changing the date, was made to produce the same impression upon the readers that it had produced upon the mind of Dr. Woodroffe, it is well to give an explanation of the circumstances under which it was sent.

When the Chief of this Bureau visited Cynthiana, in September, 1884, a number of sick animals were found among the herd of unregistered cattle, and Mr. Frisbie was then advised to have every animal in this herd carefully examined and the healthy ones removed from contact with any that presented the least signs of disease. At that time negotiations were in progress with the stockmen of the State who were trying to raise enough money to purchase and slaughter all the cattle belonging to Messrs. Frisbie & Lake, and the last-named gentlemen did not consider it to their interest to have such a separation made. It soon became evident, however, that a sufficient amount of money could not be raised to purchase the cattle, and then the owners seem to have concluded that their best plan was to separate the sick from the well ones, according to the advice mentioned above. For this purpose the following telegram was sent:

CYNTHIANA, KY., *September 27, 1884.*

Dr. D. E. SALMON, *Chicago, Ill.:*

We desire to isolate all the affected cattle in our four herds. When can you come and inspect them? Answer.

FRISBIE & LAKE.

There are two points in this telegram to which attention is particularly directed. In the first place the object of the inspection as stated in this telegram was to enable them to isolate the affected cattle. It was not to have cattle inspected for the purpose of shipping them to Texas or to any other locality, and at that time I had never received any intimation that they expected or desired to make any shipments. In the second place, they admit in this telegram having at that time four infected herds. One of these I understand to be the herd of unregistered cattle on the farm of Mr. Lake, of which A. T. Fitzwater was tenant.

At the time this telegram was received it was impossible for the Chief of the Bureau to return and make the desired inspection, and all of the inspectors in the employ of the Bureau were engaged in important work from which they could not be spared; the following reply was, therefore, sent to Messrs. Frisbie & Lake's telegram:

UNITED STATES DEPARTMENT OF AGRICULTURE,
Washington, D. C., October 3, 1884.

FRISBIE & LAKE, *Cynthiana, Ky.:*

Find I have no one that can be spared now to examine your herd. Advise employment of Dr. Hagyard.

D. E. SALMON,
Chief of the Bureau of Animal Industry.

That is, Dr. Hagyard was recommended to Frisbie & Lake as the ost available man for them to employ as a private practitioner and r the purpose of securing their private interests. The difference in (of the two telegrams is due to the former being received at n) and the answer having been delayed until my return to Washgto... Dr. Hagyard did not represent this Department in any degree, or did he have any authority to inspect any cattle in behalf of the Dett, or to give certificates of health which would relieve the v s of any responsibility which they were under, because of restrictons imposed in accordance with the act establishing the Bureau of nimal Industry.

On the 11th of January Dr. Trumbower wrote from Austin that he called on Governor Ireland, and that the governor stated that he uld do nothing and would not interfere in the matter. Dr. Trumbower ed that Mr. Frisbie declined to allow him to make an examination : the herd unless he would agree to give a certificate of health in case failed to find any cases of pleuro-pneumonia. This he could not ee to do, owing to the fact that if the cattle had been exposed before ent to the contagion of this disease they might contract it within time, even if at the time of examination they showed no symp-. Mr. Frisbie informed Dr. Trumbower that he had only shipped 24 nead and that 5 of these had died in transit.

A few days later Dr. Trumbower was recalled from Austin by order Commissioner Loring on account of the protests made by Frisbie & ake's counsel. These gentlemen pretended to believe that Dr. Trumower was prejudiced against them, and through their counsel asked hat any inspection of their cattle should be made by the Chief of the Bureau. Accordingly I left Washington January 20, reaching Cynthi-Ky., on the 21st. Mr. Lake stated that they still had about 17 head of the unregistered cattle, among which were some of the most unthrifty ones at Cynthiana. I desired to see and examine these animals in order that a definite conclusion might be reached as to whether they were actually affected with pleuro-pneumonia, but acting with the advice of his counsel Mr. Lake absolutely refused to allow such an examination. They placed this action upon the ground that in no event could the Government grant them any relief, and that every examination was liable to do them injury by revealing the presence of disease, or possibly by a mistaken diagnosis such as any one might, in their judgment, make. When his attention was called to the shipment to Texas from this herd, the suspicion that these animals were under, the vast injury that might be done to the cattle industry of the nation by the dissemination of the plague, and that a regard for his own interests, as well as for that of the country at large, would seem to make an investigation very desirable, he simply replied that they did not consider it to their interest to have such an inspection made.

To remove one point raised in his objections to inspection, I then offered that in case any one of the unregistered animals presented any signs of disease upon examination, and he was dissatisfied with the diagnosis, that I would buy and slaughter the animal in the presence of properly qualified witnesses, and thus definitely settle the question upon its merits. This proposition was also rejected. Not being able to accomplish anything at Cynthiana, I proceeded the following day to Jackson, Tenn., to investigate the condition of the animals shipped there from Frisbie & Lake's herd.

INVESTIGATIONS IN TENNESSEE.

On January 24, an examination of the cattle at Jackson revealed the following conditions:

Constance (No. 61).—Slight dullness on percussion over the lower part of the right lung. Otherwise no abnormal symptoms.

No. 2.—Dullness and slight creaking over the posterior part of right lung.

No. 136.—Fawn calf. Increased respiratory murmur over the left lung. Crepitation over the whole of right lung, with creaking sound over the upper portion, and loss of respiration and dullness over the lower posterior portion.

No. 28.—Loud and harsh respiration.

No. 153.—Increased respiratory sounds on left side and decreased on right side.

No. 22.—Dullness over posterior part of right lung.

No. 31.—Dullness over left lung, with creaking sound and diminished respiration; creaking over posterior part of right lung.

Bull (name not known).—No abnormal signs.

No. 19.—Lungs and respiration normal.

Best Regards (No. 89).—Dullness and loss of respiration over the lower posterio tion of the right lung.

Careless Lass (No. 85).—Abnormally loud respiration.

Nos. 199, 23, 94, and 68 (Balky).—Normal respiration.

Flora of Orange Peel.—Can find no signs of disease.

No. 86.—Dullness, loss of respiration, and cooing sound over the lower part o lung.

Chickapie.—Dullness, loss of respiration, and crepitation over lower part lung.

Absoloma.—Apparently in good health.

Miss Meadows.—Dullness over the whole left lung with wheezing respiration ove the superior portion.

Three calves.—No signs of disease.

This herd at Jackson was kept in close quarantine by the owners was soon taken in charge by the State authorities.

No further veterinary inspections were made of this herd until December 2 and 3, 1885, when, by request of the governor, Dr. Wray directed to make a thorough examination of each animal. The r more or less indirect, which had been received up to that time were to the effect that no symptons of disease had been observed, and that the owners were becoming impatient to have the quarantine restrictions removed. This also seems to have been the understanding of the State Live Stock Commission, as they had reached the conclusion that this herd might safely be released.

Dr. Wray's investigations brought out the fact that one calf had died, and was supposed to have had lung disease, although no *post mortem* examination was made. He also found, by an examination of the individual animals, that there were at that time nine chronic cases of pleuropneumonia. The names of the affected ones were: Sobrinette, Careless Lass, Flora of Orange Peel, Chickapie, Miss Meadows, Floss Lawrence, Nora Lawrence, Fancy Cruiser, and Cicero Sunbeam. At the time this herd was examined by the Chief of the Bureau the names could not all be obtained and the numbers were taken, so it cannot be determined how closely the two examinations corresponded. Dr. Hamilton informed Dr. Wray that our conclusions were the same in every case with the exception of Sobrinette. This cannot be the case, however, as in the first examination but seven affected ones were found. It seems likely, therefore, that two or more animals had been mildly attacked during the period that elapsed between these examinations. The death of the calf confirms this conclusion.

These facts illustrate the difficulty of deciding at what time a quarantine can be safely raised when the animals are not kept under constant veterinary supervision. Even a slight attack, that might escape the

) the owner, would be sufficient to start fresh outbreaks if the
ı) released and allowed to mingle with other cattle within six
ıths or a year afterwards. It is such facts as these that have con-
)ed the experienced authorities of the various countries of Europe
t the only safe way to deal with pleuro-pneumonia is to destroy every
l which has been exposed to it before there can be an opportuuity
ngling with uninfected cattle.
)y vice of Dr. Wray the State commissioner made arrangements
ıich this herd will be held in quarantine until October 1, 1886.

INVESTIGATIONS IN TEXAS.

eaving Jackson, Tenn., January 25, 1885, I reached Austin, Tex.,
ıuary 27. There was here a public sentiment of decided hostility to
) Bureau of Animal Industry, an evident feeling that Mr. Frisbie, who
s there in charge of his cattle, was a greatly wronged man, and that
)re was no reason for entertaining a suspicion of danger in regard to
) herd. This feeling had been worked up by and was based upon affi-
vits made by George W. Mitchell, A. T. Fitzwater, James H. Waits,
B. and J. R. Stevens, and John W. Moore, in which it was stated that
)ssrs. H. D. Frisbie and J. K. Lake, who comprised the firm of Fris-
) & Lake, were known by them to be reliable gentlemen, that they
d seen portions of the herd of cattle shipped to Texas frequently dur-
g the past six months, that they had not known of a single case of
among them during that time, and expressing the belief that
animals were free from disease, and had been so during the time
ıoned. As the unregistered animals in question had been upon the
and in the care of George W. Mitchell, John W. Moore, and A.
ıtzwater, these affidavits of their soundness carried conviction with
they were distributed as a part of Frisbie & Lake's advertise-
), and were used in the editorials of the local newspapers. I was
ıt able to understand how gentlemen who have any regard for their
tation could sign such statements or make such affidavits in view
the facts above related. It is evident, however, that such papers
ıld have a very great effect in shaping the opinions of those who had
)t been conversant with the history of the herd as detailed above.
In connection with these affidavits it may be of interest to state that
t Mr. O. A. Woods, of Cynthiana, in that town on February 7, 1885,
in the course of a conversation in regard to the cattle, he stated to
he and Mr. H. Redmond, jr., were out hunting on Thanksgiving
ay, that they crossed the farm of J. K. Lake on the far side of the river
ıe one tenanted by A. T. Fitzwater), and that they there and then
w one of the Jerseys lying dead in the field. Mr. Woods had no in-
st in the matter, and simply made this as a statement of fact. There
consequently, upon the one side the admission of Frisbie & Lake
the meeting of stockmen, and in their letter of September 18 to the
)artment, that their whole herd of 250 head had been exposed; there
ıne fact that the Chief of the Bureau of Animal Industry found sick
at the farm tenanted by Fitzwater on September 24; there is the
)ion of four affected herds in Frisbie & Lake's telegram of Sep-
27, and there is the statement of Mr. Woods that he saw one of
animals on the farm occupied by Fitzwater lying in the field dead
hanksgiving Day. On the other side there are the affidavits alluded
bove, that none of the cattle on this farm had been sick during their
n there.
)vening of January 27, 1885, I had an interview with Mr. Fris-

bie in the hotel at Austin, Tex., in presence of Maj. F. P. Holland, editor of the Texas *Farm and Ranch*, and of Colonel Cardwell, of the Austin *Statesman*. At this interview, Mr. Frisbie asserted with the most positive emphasis that none of the unregistered Jerseys had ever been exposed to pleuro-pneumonia; that he never had admitted their exposure; that none of them had ever been sick; that in regard to the two which I had picked out as sick on the farm occupied by Fitzwater, his understanding was that these only had weak lungs, that they were, however, immediately separated from the remainder of the herd and had never shown any further signs of sickness. He then asked me that in case he permitted an inspection of the herd then in Texas, and I found no cases of pleuro-pneumonia, if I would give him a clear bill of health for them. My reply was that, being satisfied that a number of the animals had recently been exposed to pleuro-pneumonia and were liable to show the disease at any time whether they were yet affected or not, I could not under any circumstances give him such a certificate as he demanded. He then absolutely refused either to allow me to inspect the living animals or to examine the dead ones and learn the cause of death. This terminated the interview. January 28 I had an interview with Governor Ireland, and laid the facts as I understood them before him for consideration, offering him the professional services of the Chief of the Bureau or of any of its inspectors if he needed such assistance. His answer was that they proposed to do things according to law in Texas, and as there was no law applicable to such a case there was nothing to be done. When reminded of the enormous live-stock interests of Texas, and of the desirability of keeping a supervision over this suspected herd until all danger was over, of the fact that the mere shipment of such a herd to his State might damage the cattle trade millions of dollars unless a thorough investigation was made, and that there were at that time dead animals from this herd in regard to which the cause of death should be ascertained, his response was that no investigations could be made except by the courtesy of Mr. Frisbie.

It was now very plain that these animals would be sold, no matter what their condition. The law establishing the Bureau of Animal Industry gave no authority to interfere, or to make an investigation against the desire of the owner of the herd, and having properly notified the State authorities the Chief of the Bureau felt that his duty and responsibility was ended until further developments should occur.

It is probably true that there was no law on the statute books of Texas for properly dealing with such an emergency, but it is equally true that the legislature was in session at the time, and, in the opinion of high officials of the State government, a law could have been obtained within a few days, if there had been a public sentiment in favor of it. As a matter of fact this sentiment did not exist, and one of the reasons was the unscrupulous manner in which evidence was collected, facts perverted, and false statements made to give the impression that there was no reason for an investigation of this herd. The affidavits published in Austin by Mr. Frisbie have already been referred to. January 9, the Austin *Daily Statesman* published an editorial which seems to have been inspired by Mr. Frisbie, and which illustrates the manner in which the case was worked up. Referring to Mr. Frisbie it goes on to say:

> He is one of the most eminent breeders in this country, and enjoys a wide reputation as such. After consultation about the best point to hold an auction sale of Jerseys he decided to come to Austin. In a copy of the Texas *Farm and Ranch*, dated December 15, there was an elaborate notice of the conclusion reached by Mr. Frisbie, and a full statement was made as to the prevalence of pleuro-pneumonia on one of his farms near Cynthiana, Ky. On one farm they keep nothing but the finest

ıred ock. Through a calf shipped to that farm from Illinois pleuro-pneumonia
on the farm, and several head of their cattle died. The rest of the dis-
ls were killed. There has been no disease on that farm for months, and
re are all in a healthy condition. But none of the cattle shipped to
were over on the farm where the disease prevailed. The cattle here were taken
arms several miles distant from the diseased herd. The cattle that reached
are evidently in a healthy condition, though they looked bad just after reach-
here from ten days' confinement in cars. These cattle have been held together
ome weeks, and veterinary authority goes to show that by this time some of these
ld have been sick had any of them been exposed to disease. The misapprehen-
at Washington arises in the fact that Frisbie & Lake had diseased cattle on one
heir farms, and this leads to the opinion that the cattle shipped to Texas, which
e never with diseased stock, were liable to disease. Mr. Frisbie is satisfied the
au of Animal Industry will set the matter all right. Early in December he ap-
d to this Department for an inspector to examine these very cattle which he was
holding for shipment to Texas, and the following telegram was received.

hen follows the telegram of October 8, referred to above, with the
e changed from October, 1884, to January, 1885, together with the
tificates of Dr. Hagyard and Dr. Woodroffe.

anuary 28, the morning after the interview between the Chief of the
u and Mr. Frisbie, in the presence of the representative of the
n, that paper came out with an editorial headed "Nothing
with those Jerseys from Kentucky," and after mentioning the
ce of this herd on the farm of Captain Love, it goes on to state:

tly after their arrival in Austin, however, a report reached here from Wash-
that the cattle were affected with pleuro-pneumonia. The report was calcu-
d to do great injury to Messrs. Frisbie & Lake, who were astonished at the
rge, knowing that their cattle were not and had not at any time been so affected.
roof of their denial the gentlemen have the following evidence:
ov. J. Proctor Knott, of Kentucky, in reply to a letter from Commissioner Lor-
states: "This clamor about disease in the cattle shipped to Texas is utterly un-
ed for and detrimental to the interests of Messrs. Frisbie & Lake." Governor Knott
eulogizes Dr. Hagyard, who inspected the herd, as an eminent veterinarian.
fter Mr. Loring received the letter from Governor Knott, the following telegram
he attorney of Messrs. Frisbie & Lake, was received:

WASHINGTON, *January* 20, 1885.

WEST, *Cynthiana, Ky.:*

ave heard from Governor Knott. Declines to act. Thinks the clamor which has
aised over this transaction has not only been uncalled for, but unjust and det-
al to the interests of Frisbie & Lake. Regret that I cannot pay expenses
uarantine under these circumstances.

GEO. B. LORING,
Commissioner of Agriculture.

following letter is from Dr. Woodroffe, who is still in the employ of the Gov-
nt:*

LEXINGTON, KY., *January* 19, 1885.

& LAKE, *Cynthiana, Ky.:*

NTLEMEN: I would advise you to flatly deny the statements that have been made
the Chief of the Bureau regarding the cattle that were shipped to Austin, Tex.
y have no earthly grounds for calling them infected, and the affidavits of those
is sufficient evidence that they were never exposed. It is simply a libel on your
and will greatly affect their sale. You can use Dr. Hagyard's and my name
y in the matter.
hen Dr. Salmon arrives, I should certainly demand the result of his examination
our stock in writing.
you feel disposed to offer a *thousand dollars reward* for the discovery of a case
-pneumonia in the herd that went to Austin do so, and I will give you bank-
ences for me for half the amount.
ours, very truly,

H. A. WOODROFFE, *M. R. C. V. S.*,
Veterinary Inspector Bureau of Animal Industry.

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* As matter of fact, Dr. Woodroffe was not in the employ of this Department at
, his services having been dispensed with January 15.

The subjoined telegram, signed by the parties whose names are appended, has been received by D. H. Frisbie, at Austin, Tex.:

CYNTHIANA, KY., *January* 17.

H. D. FRISBIE:

We have every reason to believe, and do believe, that the cattle shipped by Frisbie & Lake to Texas have never been diseased with pleuro-pneumonia, and that cows from that herd are now running at large in this county.

LUCIUS DESHA, JR.,
Presiding Judge of Harrison County.
L. M. MARLIN,
State Senator of Kentucky.
R. M. COLLIER,
County Clerk.
J. S. WETHERS,
Cashier National Bank of Cynthiana.
WM. ADAMS,
Mayor of Cynthiana, Ky.

Yesterday afternoon Dr. Salmon, Chief of the Bureau of Animal Industry, arrive at Austin. Captain Frisbie, accompanied by Major Holland and a representative the *Statesman*, called on him at his room in the Hotel Brunswick. The intervie was brief and barren of satisfactory results. Captain Frisbie put the same questi to him that he did to his predecessor: "Will you, in the event that the cattle a found in good health (as I know them to be), give me a certificate to that effect?" sa the captain. The doctor responded that he did not come here for the purpose of gi ing certificates, and would not agree to what certainly seems a fair and square prop sition on the part of the owner of the Jerseys. With this the conference broke u Captain Frisbie intends to sell his cattle on the 12th of February, at which time th will have been here six weeks. Nobody believes them to be in the least infected, a the injurious reports as to their being diseased are without the slightest foundat in fact.

The above certificates, signed by prominent citizens of H County, Kentucky, together with the letter of Governor Knott tone of the Austin press, are sufficient to explain the failure of the to have an investigation made of the condition of the Frisbie fore it was sold. Information collected later will now be introdu show the real facts of the case. At the time of the sale an adver bill was distributed on which were the statements of Dr. F. J. Smit Austin, who had examined the cattle. These statements were lished side by side by Mr. Frisbie to show that they were contradicto While the two statements may not be entirely consistent in all resp they furnish an indication of the condition of the animals at that which is not to be overlooked. The certificate of the stockmen who e amined this herd the day before the sale confirms this impression, a demonstrates that the animals were not in a remarkably healthful a thriving condition.

These documents are as follows:

Considering that the animals have come such a long trip, and the severe weath there has been *but slight mortality* among them. I visited the cattle January 25, a learned that only three had died. Two were down, and in my opinion were unab to get up. The general health of the cattle was better than I expected to find.

F. J. SMITH, *V. S.*

JANUARY 26, 1885.

The following is a statement of Dr. Smith in a circular distributed i Austin, February 11, 1885:

I visited the herd of Jersey cattle owned by Frisbie & Lake, now at Mr. Lov dairy ranch near the city, and *found a majority of the herd* sick, one dead under th shed, and another down, unable to rise; a number standing, heads extended, back arched, increased breathing, hair rough, and the animals in very poor condition. Th general condition of the herd is similar to that found in contagious pleuro-pneumoni No competent person has been allowed to make a *post-mortem* examination.

F. J. SMITH,
D. V. S., U. S. A.

AUSTIN, TEX., *February* 11, 1885.

'e, the undersigned stockmen, certify that we have this day made a careful ex-
nation of the Jersey herd belonging to Messrs. Frisbie & Lake, and found them
ı in flesh, and showing evidence of bad treatment.
'e further, at the request of the owners, selected the poorest and most sickly look-
animal in the herd, and killed it in our presence, and Drs. Carothers and Taylor
sfully examined all of its organs, and stated that they found no evidence of dis-
, and especially of the lungs.
ı our opinion the herd is free from disease, and especially from contagious pleuro-
ıia.
d as follows):
.. E. Carothers, M. D.; M. A. Taylor, M. D.; Ike T. Pryor; Seth Mabby; Geo. W. Littlefield; F. M. Maddox; C. E. Anderson; J. M. Day; W. S. Carothers; John W. Driskill; A. L. Casparis; J. R. Blocker; James W. Taylor.

This examination of a single animal selected from a herd of that size ıply because it had an unthrifty appearance was of no value in de-ing whether the remainder of the cattle were healthy or were in-ted. Animals affected with chronic pleuro-pneumonia are not always worst appearing ones in a herd; on the contrary, they are often the ry fattest and look the healthiest, as was the case with the cow which ed the outbreak in Connecticut in 1883. The only way to deter-that such a herd of animals is free from danger is for an experi-ed veterinarian to carefully examine the lungs of every animal in it auscultation and percussion, and then to keep the whole lot of them der professional supervision for three months to make sure that no new develop during that time. The examination made by the stock-ın this case was worse than useless, because it inspired a feeling of ırity in the minds of people ignorant of the characters of the dis-, while it was of no value towards demonstrating the freedom from

ı ;ion. In this case, as in many others that have come under my vation, members of the medical profession were responsible for us (ɔeiving the public in regard to their ability to detect this As a rule, the more intelligent members of the medical pro-ɔn, recognizing how much they still have to learn about those ıses which they have studied and observed, see how absurd it is r them to claim any special knowledge of maladies which they have ver studied and have never seen. But there are others, living ex-ı that "a little knowledge is a dangerous thing," who do not ıate to make the most of the confidence reposed in them by the mmunity as medical men, and assert the superiority of their knowl-lge of animal diseases to that of the veterinarian who makes them a ecialty. It is hoped that this species of quackery will in time disap-, but, nevertheless, it has been, during the last few years, a very oying obstacle in the way of suppressing animal plagues.

ow, as to the healthfulness of these animals that were taken to xas, we are at present in a position to give very conclusive evidence. r. H. W. Rowland, an inspector of the Bureau of Animal Industry, as directed to proceed to Austin early in May, 1885, and to collect all ıinable information as to this herd. He remained there until July, from his investigations the following facts appear:

The number of cattle shipped at Cynthiana was originally stated by r. Woodroffe at 125. Mr. Frisbie informed Dr. Trumbower and the of this Bureau that only 124 were actually taken. Be this as it , e number landed alive at Austin was only 118. In other words, ı 6 died between Cynthiana and Austin. Between January 6, of their arrival, and February 12, the day of sale, 22 animals 1 was slaughtered for examination by the stockmen the day

before the sale. That is, of the 124 which were shipped from ana on December 27, 1884, there were remaining alive at the sale, February 12, 1885, but 95 head.

What was the cause of death of so many animals it is imp say at this time, since the owner refused to have any ex made of either the sick or dead ones by veterinarians who wer tent to decide upon the nature of the trouble. At the time the this Bureau was at Austin, he was reliably informed that the of three animals which had recently died could be seen upon of Captain Love where the herd was kept, also that 2 or 3 h lying in the lot too sick to stand. He, however, did not have authority to make an investigation.

During the period from February 12 to July 1, 1885, it was Dr. Rowland that 23 had died out of the 95 sold at Austin. words, only 72 animals remained alive, July 1, of the 124 whic from Cynthiana. Dr. Rowland examined a considerable part o mals which were still alive at the time of his visit and made *po* examinations of a number which died. In none of these did he evidence of pleuro-pneumonia, nor could he hear of any case malady among the native cattle which had come in contact Frisbie herd. It is, therefore, believed that the contagion di tablish itself in this State. If any of the lot were affected w plague at the time of shipment or after their arrival they prob and the disease was not propogated from them.

It is, certainly, a most fortunate termination of this matter to this dreaded disease has not gained a footing on the plains c where once fairly under way it would not only be impossible to it, but where it would be disseminated through the channels merce to every part of the country. Nor is this happy result d precautionary measures adopted by the local authorities, bu spite of their carelessness after timely warning. This instan of the best illustrations that could be given of the necessity for laws to control such an insidious and, at times, obscure disease contagion had been spread by that lot of animals, as it was giv opportunity to do, no one who has studied the history of thi abroad can doubt that it would have cost our country hundred ions of dollars, and made the rearing of cattle a precarious bus all time to come.

RECENT DEVELOPMENTS IN REGARD TO PLEURO-PNEUMONIA TUCKY.

As the officers of the Bureau of Animal Industry were not al the owners of the infected cattle at Cynthiana, Ky., to go up premises and examine their animals, and as no law, either na State, existed by which such an inspection could be enforced, it necessary to suspend all action by the Bureau for the control a pation of this outbreak. Without frequent inspection it was im for the Bureau to keep informed of the condition of affairs, and knowing that the disease continued to exist we could not deter far we would be justified in attempting to enforce sections 6 and act for the establishment of a Bureau of Animal Industry, & provides penalties for the shipment of affected animals from o or Territory into another.

The continuation of the disease in the herd of M Lake, and its extension among other cattle in the vic y,

nong the stockmen of Kentucky, and even of other States,
at y ti it was liable to be carried to the most remote part of the
ntry by the shipment of exposed or affected animals.
inability to make inspections, owing to the hostility of the owners
f the infected herds, prevented the notification of such owners or of
he railroad officials as provided for in the animal industry law; and
s this law only specifies affected animals, and not those which have
exposed and are liable to become affected, it is evident that there
but slight legal restraint to prevent the dissemination of this in-
uous and dangerous plague.

A considerable number of appeals for protection and assistance were
ade to the Department by prominent citizens of Kentucky, but for a
ng time there was no plan suggested by which this could be granted.
low is a copy of a letter received from ex-Senator John S. Will-

MOUNT STERLING, KY., *June* 6, 1885.

MY DEAR SIR: The cattle plague is still lingering and killing cattle in Messrs. risbie & Lake's herd at Cynthiana; it has also appeared in a small herd of their earest neighbor. At a meeting of the cattlemen in Frankfort this week, I was appointed one of a committee to wait upon Messrs. Frisbie & Lake and see if some ngement could not be made to prevent the further spread of the disease until meeting of our legislature, when we feel sure that effective legislation will be

Loring, just before the adjournment of Congress, proposed, with the consent of ie & Lake, to put their herd in quarantine and pay the expenses of such quare if the governor of Kentucky would co-operate with him in so doing. I saw correspondence between them. The governor thought there was no necessity of action on his part, and that the Commissioner of Agriculture had as much power the subject without as with his co-operation. Dr. Loring was not satisfied with non-action of the governor, and the matter was dropped. Frisbie & Lake were only willing, but anxious, that the cattle should be put in quarantine.

I think the governor can be prevailed upon now to give his sanction and support to such measures as you may adopt, and I hope you will at once put this herd in quarantine. I have notified Messrs. Frisbie & Lake that I will be at their farm near Cynthiana, on next Saturday, the 13th instant, and I hope to have a letter from you before I leave Friday evening, renewing the proposition of your predecessor.

Very truly yours,

JOHN S. WILLIAMS.

The COMMISSIONER OF AGRICULTURE,
Washington, D. C.

To this letter the following reply was made:

DEPARTMENT OF AGRICULTURE,
Washington, D. C., June 10, 1885.

SIR: In reference to your favor of the 6th instant, to Commissioner Colman, asking if he is prepared to carry out the plan of quarantine for the herd of Messrs. Frisbie & Lake which was under consideration by Commissioner Loring, I have the honor to state that owing to the extent of pleuro-pneumonia, the small number of employés allowed the Bureau of Animal Industry, and the limited appropriation for the coming fiscal year, such a course cannot be adopted at this time. As I understand the matter, the quarantine which Frisbie & Lake are willing to accept is simply a mutual arrangement under which this Department is expected to take charge of the infected herd and pay all expenses for its care and maintenance.

A similar proposition was made by the State authorities of Missouri and was declined, se there was not sufficient funds available to undertake to control pleuro-pneuin this way. Our inspectors have found about 300 infected herds, containing l thousand animals, each of which the State authorities desire to have quarant Government expense, and it is evident that any attempt to do this would exnr appropriation in a few months without in any way reducing the extent of tion.

risbie & Lake herd has been a source of great anxiety to the Department, seems to be good reason to believe that even if by good fortune the dis- ot disseminated beyond Harrison County, it will become so firmly established to be extirpated only with the greatest difficulty.

Regretting the fact that under the present laws there is no way by which I can protect your cattle-owners from this disease,

I remain, very respectfully,

F. C. NESBIT,
Acting Commissioner.

Hon. JOHN S. WILLIAMS,
Mount Sterling, Ky.

In this connection, it may be added that the animal industry law seems to require that there shall be State legislation authorizing the State authorities to co-operate with the Commissioner of Agriculture, or at least giving some power to quarantine under State laws before this Department is justified in incurring such expenses. Otherwise the quarantine regulations might be broken with impunity and could not be maintained except by the courtesy of the owner of infected herds. Such a condition of affairs would make effective quarantine impossible and would lead to the expenditure of large sums of money without any adequate results.

This conclusion is confirmed by the decision of the Attorney-General, from which the following paragraph is quoted here as applying to this subject:

Section 3, to which you refer, authorizes the regulations by the Comm
Agriculture, and supposes that these may be adopted by State executive
or, as an alternative, supposes regulations by State executive authorit
turn it empowers the Commissioner to adopt. In either case of cou
executive action is to be authorized by competent State legislation.

The following correspondence with the secretary of the Kentucky State board of health does not need additional explanation:

STATE BOARD OF HEALTH OF KENTUCKY,
Bowling Green, Ky., June 13, 1885.

SIR: On yesterday, accompanied by Ex-Senator John S. Williams and others, I visited the herds of cattle near Cynthiana, in this State, now and for some time past affected with contagious pleuro-pneumonia. There are two herds involved in the trouble—on adjoining farms—one containing about 100 head and the other 16 head. The danger of infection of the cattle of this entire section seemed so great that, u a clause of our health law which gives us supervision of the food supply of the ple of the State, I have placed both the herds of cattle in a provisional quaran for one month, in order to confer with you with the view of securing such assist as you may be authorized to give, looking to permanent protection for our cattl terests against this disease.

There is a serious question as to the extent of it, but whatever quarantine powe has been conferred by our legislature is vested with us, and we are ready to co-op erate with or indorse any measures you may propose which will rid us of this dis or tide over the emergency until the meeting of our legislature in December. have not had the question of jurisdiction raised here, as the owners of the cattle ready to accept any reasonable proposition from us which promises relief.

I have the honor to be, very respectfully, your obedient servant,

J. N. McCORMACK, *Secretary.*

COMMISSIONER OF AGRICULTURE,
Washington, D. C.

This letter inclosed a quarantine notice as follows:

QUARANTINE NOTICE.

OFFICE OF THE STATE BOARD OF HEALTH,
Bowling Green, Ky., June 15, 1885.

Whereas it has come to the knowledge of this board that contagious pleuro-pneumonia now exists in the cattle herds of Frisbie & Lake and William T. Handy, in Harrison County, in this State; and whereas this disease is highly infectious, and its existence seriously jeopardizes the food supply of the State: Now, therefore, be it

wn that the State board of health, in the exercise of its authority in supervising
ealth interests and food supply of the people of this Commonwealth, have placed
aid herds of cattle in quarantine, and for this purpose have established and set
t the farms of said Frisbie & Lake and Handy as quarantine grounds, and they
by command the said Frisbie & Lake, and Handy, and all others, not to remove
cattle, or any one of them, from the grounds so set apart, nor permit them to
e near any public highway; and the people of Harrison County, and all others,
hereby commanded and warned not to permit any cow or cows to run at large
the public highways, or otherwise to come near such infected cattle.
authority of the State board of health.

J. N. McCORMACK, M. D.,
Secretary.

DEPARTMENT OF AGRICULTURE,
BUREAU OF ANIMAL INDUSTRY,
Washington, D. C., June 23, 1885.

: This Department has been requested by some cattlemen of your State to co-
rate with your board, if possible, in maintaining the quarantine of Frisbie &
te's herd at Cynthiana, until the next meeting of your legislature, or until the
t session of Congress, when some provisions may be made for the extirpation of
disease. The Department will cheerfully do anything that is possible to assist
or to co-operate with you if your board desires such co-operation. I do not think
t we could assume any quarantine expenses that would include the maintenance
nals, but we could probably send a man to Cynthiana to see that the quaran-
ules were enforced and to practice such disinfection as might be called for at
time. I think it would be a great relief to your cattle industry if we had some
tent person there, acting with some authority under your law, who could state
is own observation that there was no further danger of the spreading of the
ase.
shall be very glad to hear from you in regard to this matter, and hope you will
e any suggestions that may occur to you.
Very respectfully,

D. E. SALMON,
Chief of Bureau.

r. J. N. McCORMACK,
Secretary State Board of Health, Bowling Green, Ky.

BOWLING GREEN, KY., *July* 25, 1885.

I have the honor to inform you that I have this day completed the arrange-
for the permanent quarantining of the herds of infected cattle at Cynthiana, and
quest you to send a competent veterinarian to that point to assist this board in pre-
ting the spread of the disease. In the absence of distinct authority for such
rantine, it has to be arranged by mutual agreement; hence the delay. The cat-
en have placed in my hands a limited amount of money for the maintenance of
cattle, but not enough for this purpose and the policing. The herds are at pres-
under the control of Dr. Hervey McDowell, of Cynthiana, and have been for the
month, and he will continue in charge until I hear from you. If it is in your
er I would like for you to provide some compensation for McDowell, as he has
much excellent work gratuitously.
re is little change to report in the condition of the cattle since my last letter.
cow sold by Frisbie & Lake last fall infected two milch cows belonging to two
ers in the immediate neighborhood. The cow was not suspected of being dis-
d until within the last few days, when she was returned to Frisbie & Lake's herd,
the two exposed cows killed.
believe we have the disease under control, but not having the fullest confidence
of the parties interested, think it will require much care and discretion to
so, and I therefore request that you send us the very best man you can get to
the quarantine.
espectfully yours,

J. N. McCORMACK,
Secretary State Board of Health.

D. E. SALMON,
Chief of Bureau of Animal Industry.

DEPARTMENT OF AGRICULTURE,
BUREAU OF ANIMAL INDUSTRY,
Washington, D. C., July 28, 1885.

SIR: I am in receipt of your favor of the 25th instant, requesting that this Department should send a competent veterinarian to co-operate with your board in maintaining the quarantine of cattle affected with pleuro-pneumonia at Cynthiana.

I have conferred with the Commissioner of Agriculture, and we have decided to station such a man there the 1st of next month.

I see no way that we can legally compensate Dr. McDowell for his services. I am sorry that we cannot, for I am satisfied that the work of your board has been of very great value to the country at large as well as to the State of Kentucky. We have not yet finally determined on the man for the place, but will notify you within a day or two.

Very respectfully,

D. E. SALMON.
Chief of Bureau.

Dr. J. N. MCCORMACK,
Secretary State Board of Health, Bowling Green, Ky.

July 29, 1885, Dr. William H. Wray was appointed an inspector of the Bureau of Animal Industry, and was directed to report for duty as soon as possible. He reached Washington August 3, and after receiving detailed instructions as to his duties and authority, proceeded at once to Cynthiana. He was to investigate the extent of the plague at that time, to learn how many cattle had been exposed, and to take such action as was possible, under the animal industry law, the statutes of Kentucky, and, with the consent of interested parties, to arrest the dissemination of the contagion and extirpate the disease. He was directed to co-operate with the governor, the State board of health, and the cattlemen in any legal measures looking to this result.

Additional and interesting correspondence regarding the condition of affairs at that time is given below:

SIDEVIEW, MONTGOMERY COUNTY, KENTUCKY,
July 28, 1885.

SIR: By letter just received from Dr. E. T. Hagyard, veterinarian, of Lexington, Ky., I am informed that through H. D. Frisbie (of Frisbie & Lake), he learns that contagious pleuro-pneumonia "has appeared in several instances amongst the cattle in Cynthiana and the neighborhood." Can we not have the advantage of a portion of the fund set aside by Congress for isolation of all the cattle of that locality? I am now satisfied, by a recent letter from Governor Knott, that he will do anything he can to aid the Department in its acts in this respect. A few of us cattlemen have furnished our State board of health the funds for guarding and isolating the Frisbie & Lake herd, but I am satisfied we cannot raise the means privately for isolation of the whole locality.

Yours, respectfully,

T. CORWIN ANDERSON.

Hon. NORMAN J. COLMAN,
Commissioner of Agriculture.

LEXINGTON, KY., *July 29,* 1

SIR: Your letter received. Since writing you I have had a conference with McCormack, and we have just completed arrangements with Frisbie & Lake to —— their cattle until January 15, 1886, subject at all times to the control of the board of health, or to any one acting for them.

This will give any one whom you may send the right to inspect the cattle at any and all times, and they will have no say in the matter. I have raised the necessary funds to carry the same in force, and believe with your assistance we can have the most efficient quarantine in the country. I feel much better satisfied as to the condition of affairs, and have just learned that our governor has expressed a d — assist.

Yours, truly,

W. W. ESTILL.

Dr D. E. SALMON,
Chief of Bureau of Animal Industry.

BOWLING GREEN, KY., *August* 3, 1885.

: I am just in receipt of your telegram, and a letter from Dr. McDowell, telling ,i fresh cases of pleuro-pneumonia from a cow sold from Frisbie & Lake's herd fall. I am not fully advised as to the extent of the danger, but will go up as ı as I hear from Dr. McDowell after Dr. Wray's arrival, if it seems necessary.

Very respectfully,

J. N. McCORMACK,
Secretary State Board of Health.

r. D. E. SALMON,
Chief of Bureau of Animal Industry.

DEPARTMENT OF AGRICULTURE,
Washington, August 3, 1885.

IR: I have the honor to acknowledge the receipt of your favor of the 30th ultimo, osing a communication from Mr. T. C. Anderson, of Sideview, Ky.

have been in communication with the State board of health since they have placed Frisbie & Lake herd in quarantine, as to what means could be adopted for co-tion between this Department and your State board. As a result of this corre-ence, I have just ordered Dr. William H. Wray, an inspector of the Bureau of l Industry, to proceed to Cynthiana and take charge of the quarantined herds see that the quarantine is properly maintained. In addition to this the De-nt will authorize the expenditures necessary to make the isolation complete ure such disinfection as may be necessary to prevent the extension of the

a copy of the act establishing the Bureau of Animal Industry, and also a the "Rules and regulations" adopted by me for co-operation between the ted States Department of Agriculture and the authorities of the various States Territories. As there is no State law authorizing the destruction of diseased cat-I am willing to waive that part of the regulations which require this of the States, will do whatever is possible under the animal industry law.

Vith the rigid enforcement of the provisions of the national law bearing on this together with those on the statute books of Kentucky, it would seem that the antine might be maintained so efficiently as to prevent the further extension of disease, and which would also relieve your State of the restrictions which other have placed upon its cattle.

Very respectfully,

NORMAN J. COLMAN,
Commissioner of Agriculture.

on. J. PROCTOR KNOTT,
Frankfort, Ky.

he following rules and regulations are the ones referred to in the ve letter:

s and regulations for co-operation between the United States Department of Agricult-e and the authorities of the States and Territories, for the suppression and extirpation contagious pleuro-pneumonia of cattle, in accordance with section 3 of the act estab-ıg the Bureau of Animal Industry.

properly constituted inspectors of the Bureau of Animal Industry are to be orized by the governor of the State to make inspections of cattle, and to be as-d by local police authorities when this is necessary.

In case of a discovery of contagious pleuro-pneumonia among the animals of State, the inspector will immmediately report the existence of the disease, the ber of animals affected, and the number exposed to the governor of the State or officer or board which the governor may designate; and he will also report the o the Bureau of Animal Industry.

When the governor of the State or other designated officer is satisfied of the ence of pleuro-pneumonia as reported, all the affected and exposed cattle and ted stable and premises shall be placed in quarantine under State laws, such ine to remain in force until at least three months after the destruction of the ted animal. The animals which are sick with the disease are to be immedi-tered by direction of State officers and under State laws, and at the ex-State. (In newly infected districts it is earnestly recommended that all sed animals be immediately slaughtered.)

The rules of quarantine shall be such that no animal sick or well can leave the l herd except for slaughter, or to be taken into it during the period of quaran-, the attendants of infected animals shall not be allowed to visit healthy herds

except after change of clothing and shoes, nor shall any persons from other premises be allowed to go among the infected cattle except by special permission.

(5) The inspectors of the Bureau of Animal Industry shall be authorized to visit quarantined animals and inspect them as often as may be necessary, and no quarantine restrictions shall be removed until the Chief of the Bureau of Animal Industry certifies that this may be safely done.

(6) The Chief of the Bureau of Animal Industry shall be authorized to carry out such measures of disinfection in regard to infected premises as he may consider necessary.

(7) The salaries and expenses of the inspectors of the Bureau of Animal Industry, the necessary expenses of maintaining quarantine under the conditions prescribed above, and the expenses of disinfection will be paid out of the fund appropriated by Congress for the work of the Bureau of Animal Industry in accordance with the law approved May 29, 1884, but no compensation will be allowed for the food or ordinary care of animals in quarantine.

(8) In order to prevent the spread of the disease from one State or Territory into another, the owners of infected herds in the various States, and the railroad and transportation companies doing business in their vicinity, will be notified by the Commissioner of Agriculture of the penalty provided for the violation of sec 6 and 7 of the act referred to.

NORMAN J. COLMAN,
Commissioner of Agriculture.

WASHINGTON, D. C., *July* 1, 1885.

The inspections made by Dr. Wray demonstrated once again the insidious and progressive character of this plague. While little was known to the outside world of any new cases of disease among the cattle at Cynthiana, while even those in the vicinity who had endeavored to keep informed were ignorant of any serious extension beyond the originally infected herd, the professional inspection showed that a number of herds were affected, and that many cattle had been more or less exposed. The particulars in regard to this will be found in the following letters from Dr. Wray which summarize the results of his work:

CYNTHIANA, KY., *August* 17, 1885.

SIR: During the past week I think I have got the disease here within bounds, having located most, if not all, that have been exposed to the contagion. I am trying to get the board of aldermen to pass an ordinance prohibiting all driving or leading of cattle through the public streets. I wrote Dr. McCormack, of the State board of health, to come here in person, which he did on Thursday evening, August 8. On Friday, at Dr. McCormack's request, a meeting was held at which resolutions were passed, so we can put all cattle that have been exposed (with the exception of Frisbie & Lake's) in two fields on Mr. Handy's place, which is now in quarantine. This will necessitate some fencing that I will have done. We propose to put the infected and exposed ones in one field, and the sick or diseased ones in another. At the same meeting money was subscribed to pay the expense of those that were in quarantine until the 15th day of January, 1886. I have followed up most of the cases that have been exposed, and will so continue until all have been inspected. I followed one to Cincinnati that was shipped Saturday evening, August 9, from here, and saw her sold to a butcher and killed.

Frisbie & Lake have endeavored to keep the herd on the Cox place, east of town, as clear as possible, by sending those that showed any symptoms of the disease over to Mr. J. K. Lake's, on the Falmouth pike, among those that are so badly diseased. There is no change in the cows belonging to M. Bridwell, J. S. Withers, and O. Slade, which are pastured in Rule & Maffitt's lot adjoining J. K. Lake's. On August 14 I killed the bull Glory of Pleasant Hill, in the presence of Dr. McCormack, of the State board of health, and with J. K. Lake's permission. On examination before death the temperature was 103⅘° F., with dullness over the whole of the left side of the chest, and complete loss of respiratory murmur, with a gurgling sound at each inspiration. On *post mortem* I found the pleura adhered to the ribs and diaphragm, the pleura being three-quarters of an inch in thickness. On opening the pleura about 3 gallons of dark purulent liquid escaped and exposed the center of the lung which was in an advanced stage of infarction. The right lung and the anterior lobe of the left was in a comparatively healthy condition.

Respectfully yours,

W. H. WRAY,
Veterinary Inspector.

Dr. D. E. SALMON,
Chief of Bureau of Animal Industry.

CYNTHIANA, KY., *October* 12, 1885.

R: Much progress has been made in stamping out pleuro-pneumonia during the week by Frisbie & Lake killing all their sick animals. As they have made the t I think all others will follow. Among those condemned was Nutrina of Tunlaw. xamination she had a temperature of 100⅘° F., and slight dullness over central ion of right lung. On *post mortem* examination found adhesions to second, third, fourth ribs on left side, and also second, third, fourth, fifth, and sixth, with a cyst 3 es in diameter on right; membrane of cyst was very nearly one-half inch in thick-; adhesions on right side were very tenacious. The following is a list of those d with Frisbie & Lake's herd: No. 22, Jessie Laurence; No. 147, Fay St. Helier; No. Duke's Emblem; No. 27, Hinwoor; No. 148, Lady St. Helier; No. 2, Rissa Cicero; grade calf; one spotted heifer; No. 89, Pardon; bull, Hannibal Duke; No. 88, ies Hadez; the Jos. Stevens cow; No. 92, Dora Willwood; No. 80, Countess Georg-a; No. 149, Flora St. Helier; grade spotted cow Camel; spotted heifer; three grade fers; bull out of Dora Willwood; bull calf; calf out of Countess Georgiana, and trina of Tunlaw.

Respectfully yours,

W. H. WRAY,
Veterinary Inspector.

Dr. D. E. SALMON,
Chief of Bureau of Animal Industry.

CYNTHIANA, KY., *November* 16, 1885.

SIR: During my stay here I have found pleuro-pneumonia at the following places, s: Frisbie & Lake's, W. T. Handy's, Rule & Maffitt's, M. Bridwell's, J. T. Wither's, T. J. Megibben's, at Cynthiana; on the places owned by W. T. Moreland and ·ng Cox, at Indian Creek neighborhood, 3½ miles east of Cynthiana, and at D. N. nock's, near the Pendleton County line, 13 miles north of Cynthiana. The con- was spread at Cynthiana in the body of a cow sold to Joseph Stevens by ·ie & Lake in the month of October, 1884, and not delivered until December 24, when she was taken to Mr. Handy's, where she remained three weeks. (Mr. y's stock became sick some time in February, 1885.) She was then taken to Mr. ens's own place until she calved, which was about May 1, 1885. While at Mr. ens's place she came in contact with his mother's cow, which sickened and died t the middle of July. She was then taken to Rule & Maffitt's lot and kept there July 1, 1885, when she was taken back to Mr. J. K. Lake's and pastured on the ·ourse pasture. This cow had a cough and looked unthrifty all last winter and . On inspecting her, August 13, 1885, I found her suffering with acute and ·nic pleuro-pneumonia. D. N. Brannock's herd was bought at the auction sale ld here on June 2. As there was no quarantine established at that time and a great al of driving and intermingling of cattle, I think they got the contagion from pass-g Rule & Maffitt's lot while on their way to Cynthiana to be sold. W. S. More-nd's cow was pastured next to Irving Cox, at the Indian Creek neighborhood, Mr. x having taken his herd of 13 head, which had been pastured next to Frisbie & ke's herd on the Cox pasture, to Indian Creek some time in June. T. J. Megib-n's pasture was infected by a cow belonging to James Riche, which had been past-ed in Rule & Maffitt's lot all the spring, and was taken to F. J. Megibben's place me time in July. In August she was sold to a butcher in Cincinnati and killed. Frisbie & Lake's whole herd was kept at J. K. Lake's home place during the win- of 1884–'85. They were turned out on pasture April 17, 1885, the healthiest in ap-arance going to the Cox pasture, 1½ mile east of Cynthiana. The milch cows were pt at the home place, and those that were sick, or had shown any symptoms of being thrifty were put on the race-course pasture. The 21 head that went to Tennessee re taken from Lake's home place some time during the winter. Frisbie & Lake ve had 3 die since they have had the disease in their herds. As soon as they were rinced that there was no remedy for the disease and an animal showed symptoms eing sick, it was killed and buried. Fourteen were thus destroyed, and these, th the 3 animals that died, make 17 head disposed of before August 1. On my al on August 4, there were 41 head on the Cox pasture, 17 head at the home , 27 head on the race-course pasture, and 2 at H. D. Frisbie's house, making a of 87 head. On October 7, 1885, I killed and buried 7 head from the Cox past-. On August 14 I killed the bull Glory of Pleasant Hill; on August 17 one heifer on August 29 I killed two heifers, and on October 7 I killed 17 head from the ourse pasture; on October 8 I killed two animals from the home place. Frisbie -ke had some cattle on a place of Mr. Lake's, 3½ miles from town, on the Cynthi-nd Falmouth pike. I believe this is the herd that went to Texas. Mr. Lake this place last spring.

On W. T. Handy's place were 21 head, 19 of which were Mr. Handy's, 1 of Mr. Woolwinder's, and 1 belonging to Mrs. Roberts. One heifer of Mr. Handy's died August 19, 1885. He has 9 head suffering with chronic pleuro-pneumonia. Mrs. Roberts's cow has pleuro-pneumonia in a chronic form. Mr. Woolwinder's cow was sold to the butcher some time in October. In Rule & Maffitt's lot I found 7 head belonging to different owners, as follows: O. Slade, 1 cow (chronic form), killed October 20, 1885; J. N. Slade, 1 cow, got fast under distillery and died; P. Barhart, 1 cow, sold to the butcher; J. W. Lang, 1 cow, sold to the butcher; J. D. Fuback, 1 cow, suffering with acute pleuro-pneumonia, and was killed in the presence of W. H. Ross, D. V. S., October 28, 1885; Marion Rule, 1 cow, sold to the butcher; T. J. Maffitt, 1 cow, killed August 22, 1885, had acute pleuro-pneumonia previous to my arrival. Several others which had been kept in the same field, but had been taken home by their owners, as follows: C. R. Kimbrough, 1 cow; Dr. Hedges, 1 cow; John Stevens, 1 cow; Mrs. Stevens, 1 cow, taken sick July 10, and died in about ten days; T. Brashears, 1 cow, was found suffering with acute pleuro-pneumonia and was killed in the lot about July 20. This lot is now empty, all the animals having died, been killed, or were disposed of to the butcher. J. S. Withers had 2 cows in his lot adjoining Rule & Maffitt's. One was killed October 10. She had chronic pleuro-pneumonia. The other is now suffering with acute pleuro-pneumonia, and will likely be disposed of this week. Mr. Bridwell had 6 cows in his lot adjoining J. S. Withers, 3 of his own, 1 of J. T. Hedges, which was sold to M. Bridwell, and 2 of George Edsall's, which were killed by him and sold for beef. An animal belonging to M. Bridwell, killed October 12, 1885, had chronic pleuro-pneumonia. A. Perrin has 1 cow in the distillery lot adjoining Rule & Maffitt's on the east. T. J. Megibben's lot contained 78 head, 3 of which were killed October 19, 1885, and found afflicted with chronic pleuro-pneumonia. W. S. Moreland had 1 cow that was killed September 1, 1885, that had acute pleuro-pneumonia. Irving Cox has 13 head, 5 of which could only be inspected, as the balance were too wild to catch. Two of those inspected were found affected with chronic pleuro-pneumonia. D. M. Brannock had 17 head, 3 of which had chronic pleuro-pneumonia. The whole herd was killed and burned by a mob on the night of September 22, 1885.

If you desire the names of the 7 head affected in the chronic form in the herd that went to Tennessee, I can get them and the herd register number for you.

Respectfully yours,

W. H. WRAY,
Veterinary Inspector.

Dr. D. E. SALMON,
Chief of Bureau of Animal Industry.

OUTBREAK OF PLEURO-PNEUMONIA IN MISSOURI.

While investigating the dissemination of the contagion fr
infected herds in Illinois, I learned from the Messrs. Tripp that a
bull had been sent from their herd, at Peoria, to a lunatic asyl
Missouri, which they thought was located at Clinton. At the tim
shipment the disease had just appeared among their cattle, but one or
two had been affected, and they did not suspect the true nature of
malady. They had received information after the arrival of t
in Missouri that it was in good health and apparently thriving.
order that I might be promptly informed should any disease be
veyed by it, I wrote, under dated of October 18, to the superin
at the lunatic asylum No. 1 stating the facts in regard to the shi
of this calf from Mr. Tripp's herd, asking in regard to its pr
dition, and requesting early information in case any symptom of
disease should be observed. Mr. C. O. Atkinson, steward of the
lunatic asylum at Fulton, Mo., replied to this letter on October 25,
ing that the Messrs. Tripp had informed him of the disease in
herd, and that they had at once separated the animal which had c
from there and kept him away from all the other cattle until the
of October. He also stated that this animal and all the others on
farm were well, and that none of them had shown any signs of the
also, that if they observed any suspicious symptoms they would
the Department at once. No further information was received

;ard to this herd until late in February, 1885, when the following let-
er, mentioning the existence of the disease, reached the Department:

STATE LUNATIC ASYLUM,
Fulton, Mo., February 21, 1885.

SIR: On the 18th of October of last year you wrote making inquiry about the bull
alf we purchased of Messrs. Tripp, of Peoria, Ill. I replied at once, stating we had
xcluded the animal from contact with all other cattle, that his health was good, as
as that of our entire herd. We kept him apart from all other cattle for one hun-
red days, though he was in the barn with our herd for the first ten days after we re-
eived him from Peoria. His health has been apparently good up to the present time.
f at any time he has been ailing it was so slight as to escape our notice.

Within the last three weeks a fatal malady has appeared among our dairy herd, the
ymptoms, from the first, being alarming and distressing. The cows attacked from
he first breathe very rapidly and with much difficulty; mouth open; tongue pro-
ed; frothy saliva (in some cases mingled with streaks of blood) streams from the
..th to the ground; legs and horns cold; tenderness along the spine; little or no ap-
; restless, with neck extended and nose lowered; pulse about 84.

have examined the lungs of the dead animals and find them more or less hepa-
ized in every case. In two cases almost the entire lungs were in this condition; in
other partially so, and in one only the upper or smaller lobe of the right lung was
his condition. This last cow died very suddenly. She ate bran and chop at 4 o'clock
he morning. Soon after she was discovered to be breathing hard, and died at
nt 10 o'clock the same morning. The walls of the windpipe in this case were
ned until the air passages near the lungs was not large enough to admit my
inger.

are greatly fearing contagious pleuro-pneumonia from the symptoms given.
is your opinion? And what would you advise?

Yours, respectfully,

C. O. ATKINSON, *Steward.*

P. S.—Do you think it possible the bull could have communicated the disease with-
ut having it himself?

C. O. A.

Dr. D. E. SALMON,
Washington, D. C.

Dr. Trumbower, who was then in Arkansas, was immediately notified by telegraph to proceed to Fulton and make a thorough investigation of the nature of the disease affecting these cattle. On March 2 he telegraphed from Fulton that an examination of the animals confirmed a strong suspicion of pleuro-pneumonia. One case was then developing and assuming the acute type. On March 5 he telegraphed that contagious pleuro-pneumonia among the cattle on the farm was positively ascertained on *post mortem* examination. One acute and seven chronic cases remained at that time. On March 5 Dr. Trumbower wrote that 9 head had died or had been killed from the asylum herd since the middle of January and previous to his arrival. On the preceding day Dr. Smith gave him permission to destroy a cow which he discovered to be sick on the morning of the 3d. She had refused to eat her feed during the night and yielded only one-half the quantity of milk. Her temperature was 105.8°, dullness over the lower half of the left lung on percussion. On the 2d he had picked her out as a chronic case, together with seven others. She had not been suspected of being diseased by dairymen, and, in fact, looked better on the 2d instant than many the other cattle in which he had failed to detect evidence of the . On the morning of the 4th the temperature was 105°; there slight moan and rapid effusion going on into the chest. She was in the presence of Dr. Smith and three of his assistant physicians. opsy showed in the left lung the typical lesions of the disease; rbling was very plain with interlobular exudation, infarction, organized lymph exudate in the thorax. The witnesses were ughly convinced as to the nature of the disease. Dr. Trumbower

had carefully examined the bull that was purchased from Mr. Tripp and found circumscribed dullness on the left side from the center of the lung with crepitation at the inferior part of the chest on the right side. The herd comprises 74 head, including calves, yearlings, bulls, and cows.

Dr. Trumbower urged the destruction of every animal on the place as the only means of promptly extirpating the disease. On March 6 two other cows were killed in the presence of the board of managers of the State lunatic asylum and of Professor Sanborn, dean of the agricultural department of the State University. One of these presented very marked symptoms of pleuro-pneumonia in the chronic stage. When killed there were found to be very strong adhesions of the posterior lobe of the left lung to the ribs. The whole surface lying against the diaphragm was firmly attached to this organ, and it was very difficult to dissect it away without cutting into either the lung or the diaphragm. A section through the lung opened a sac 12 inches in length by 6 inches wide in the center. The contents were partly broken down, necrosed lung and necrosed lung tissue and the pus resulting from its disintegration. On March 10 Dr. Trumbower wrote that he had just made two more autopsies to demonstrate the nature of the disease to a special committee from the legislature. These were very marked cases of pleuro-pneumonia, and convinced the committee of the existence of the disease. On the 9th he made an autopsy to demonstrate the disease to Hon. N. D. Thurmond of that district. Like many others, Mr. Thurmond had been skeptical of the nature of the trouble, but was apparently convinced after seeing this case. Of the 25 milch cows remaining in the asylum barn on the 10th not more than 5 were entirely without symptoms of the plague.

The fact of the existence of lung plague in the herd belonging to asylum having been fully established, much uneasiness was felt by people of Callaway and surrounding counties lest it might sp other herds and localities. That they might have the aid and as of the Government in their efforts to suppress it the Commissio Agriculture was urgently requested to permit Dr. Trumbower to and superintend the necessary measures for its extirpation. S Cockrell and Vest were also earnestly appealed to, and requested urge upon the Commissioner the importance of lending all the aid in power. Among others who signed these appeals were the follow named citizens of Callaway County: Dr. T. R. H. Smith, superi ent and physician State lunatic asylum; Charles A. Bailey, W Harrison, John A. Hockaday, J. L. Erwin, B. P. Bailey, treasurer lunatic asylum; F. Lorenz; W. H. Dawson, J. H. Buchanan, and R. Carter, members of city council of Fulton; J. B. Snell, mayor Fulton; T. A. Baulwave, city attorney; John McGregor, counci W. L. Fisher; J. C. Yantis and Edwin Card, members State l asylum board; George McIntire, city marshal of Fulton.

On March 19 Dr. Trumbower wrote that a new board of as managers had recently been appointed, that they had met for the t action of business on the preceding day, and he had killed 1 sick co to demonstrate the nature of the disease to four physicians who were on the board. The animal presented typical lesions of the disease, and the board passed the following preamble and resolutions:

Whereas a destructive disease is prevailing in the herd of cattle belonging t institution, some 16 or 17 head having died already, and as many more showing s toms of the disease; and

Whereas a United States veterinary surgeon, Dr. M. R. Trumbower, has been two

s weeks making full and thorough examination of said herd, and from these gations and *post mortem* examinations (one of which was made in the presence ... board) he unhesitatingly pronounces the disease to be the contagious pleuro- ...onia; and

...ereas said Trumbower declares the idea of quarantining an inefficient and uncer- remedy for the evil, having been tried and found unsuccessful after fifteen or ...teen months' rigid enforcement; and

'hereas the cattle interests of our State demand the stamping out of the disease: *...solved*, That the superintendent be, and is hereby, instructed to kill the entire ... of cattle as soon as he is in possession of an opinion from the State attorney- ...eral that such an order is within the legal power of this board, and as soon as the ...nosis of Dr. Trumbower will have been confirmed by some other eminent au- ...ity.

Dr. Hagyard was selected to confirm Dr. Trumbower's diagnosis. On ...rch 22, Capt. James H. Payne, of Kansas City stock-yards, Mr. A. B. ...tthews, of Kansas City, Mr. C. M. Lackland, of Mexico, Mo., accom- ...nied by Veterinarians Adair and Dundas, of Kansas City, and by Dr. ...tes, of Bates City, arrived at Fulton for the purpose of making an ...estigation in regard to the nature of the disease with which the cattle ...re affected.

There seemed to be still a strong feeling that some mistake had been de, and that the malady was not pleuro-pneumonia. The veterina- first agreed among themselves as to the appearance which the s should present in case the disease was pleuro-pneumonia. They slaughtered an affected animal and all agreed that the lesions were ...se of this disease, and all these parties were so thoroughly convinced t did not ask for the slaughter of a second animal, which was ... if they desired it. On the morning of March 22, the bull which ...rom Illinois was killed in presence of Dr. Hagyard. The left was found adherent by fibrous bands to the pleural surface of the al column and ribs. In the anterior lobe four small cysts were found ...ining lung tissue in a state of disintegration. Another animal was ...ed for examination, and in the lung was found a very large cyst en- ng necrosed lung tissue. The lung of the third cow contained a what smaller cyst, which was evidently not of so long standing as ... other case.

...r. Hagyard had no hesitation in declaring the disease pleuro-pneu- and the other veterinarians were equally positive.

...n March 27, 27 animals of the asylum herd were slaughtered in the ... of Dr. Holcombe, State veterinarian of Kansas. There were y ... of these which did not show some evidence of lung affection; ny of them had encysted masses of dead lung. The following day 5 ...s, 14 two-year-old heifers, and 13 yearling heifers were slaughtered. ... of these presented evidence of the ravages of this disease. On ...ch 31, 5 cows, being all that remained of the herd, were slaughtered ...ne presence of the cattle-owners of that section, who held a meeting ...t day at Fulton. All these showed plain evidence of pleuro-pneu- ...nia.

The following telegram from Governor Marmaduke and Congressman ...nd needs no explanation:

JEFFERSON CITY, MO., *April* 4, 1885.

our attention is respectfully invited to the fact that in the county of Callaway, ...State, pleuro-pneumonia exists in a dangerous form, affecting several herds of ...le, and liable to spread and affect other herds to the great damage of the citizens ...of. It is, therefore, earnestly requested that whatever power you may have un- laws of Congress, and particularly the act of Congress of May 29, 1884, be ...d by you in the manner contemplated by said act in the suppression of said ... to use such appropriation and means as may be authorized by such act in ... Immediate and vigorous action is requested. We have visited the local-

ity affected, and can certify to the facts above stated. Over one hundred head of diseased cattle have been killed, and in the opinion of the veterinary surgeon (Dr. Trumbower), now on the ground by authority of your Department, many others are believed to be affected. The citizens of the county are doing their whole duty in contributing their money and time in the effort to stamp out the disease. Dr. Trumbower has given valuable aid by his skill and experience in the detection and suppression of the disease, and any further aid your Department can render in aid of the efforts of the people of the county will be of great value to them and the State.

The State authorities will use all the limited powers given them to co-operate in stamping out the plague.

JOHN S. MARMADUKE.
R. P. BLAND.

Hon. NORMAN J. COLMAN,
Commissioner of Agriculture, Washington, D. C.

April 5, Dr. Trumbower reported that 18 animals that had been grazing in a field adjoining the asylum grounds had been slaughtered and that 6 of these which were examined after death were p affected with the disease. A rainstorm prevented the examination the remaining 12 carcasses. Other herds had also been exposed, and owing to the danger that infected animals would be shipped, the following notice was sent to the president of the Chicago and Alton Rail Company:

DEPARTMENT OF AGRICULTURE,
BUREAU OF ANIMAL INDUSTRY,
Washington, April 6, 1885.

SIR: Under section 7 of the act establishing the Bureau of Animal Industry, it my duty to notify you that the contagious pleuro-pneumonia of cattle exists at Fulton, Mo., and in that vicinity, and that to receive any cattle affected with this disease for shipment will render your company liable to the penalty prescribed in said act, copy of which is inclosed for your information and guidance.

Very respectfully,

E. A. CARMAN,
Acting Commissioner.

T. B. BLACKSTONE, Esq.,
President Chicago and Alton Railroad, Chicago, Ill.

About this time requests were made by the superintendent of Kansas City stock-yards and by stockmen in other sections of M for the appointment of local inspectors whose duty it should be to amine cattle intended for shipment and certify to their healthful These requests were occasioned by restrictions placed upon the movement of cattle from this State by the authorities of other W States. On account of the limited number of employés which t reau is authorized to have upon its roll at any one time, it was impossible to station inspectors in the various parts of the State they were desired.

On April 10, Dr. C. B. Michener, of New York, was direc telegraph to proceed at once to Fulton, Mo., and assist Dr. Trum It was hoped that by a rigid supervision and isolation of the that vicinity there would be no necessity of inspectors at other and that neighboring States could be induced to allow unre shipments of animals from the counties that had not been infecte

The condition of affairs on April 19 is summarized in the follo communication from Dr. Trumbower, and in the notice and the re of the citizens' executive committee given below:

FULTON, MO., *April* 19, 1885.

SIR: One hundred and thirty-nine head of cattle, including the asylum herd, have been killed. About 300 more, which are now known to have been directly exposed should be killed. From 500 to 800 others, which have had opportunities for ex

main; they have not yet been examined. All the money raised for the of infected herds has been expended.
still sanguine of success. Two conditions exist which are favorable, viz., xtension of the disease, considering the opportunities afforded; the evidently subacute or chronic type of the outbreak.
rs truly,

M. R. TRUMBOWER,
Veterinary Inspector.

E. SALMON,
f of Bureau of Animal Industry.

llowing is the appeal issued by the citizens' executive commit-

ple of Callaway County:

ell-established fact that contagious pleuro-pneumonia is now prevailing to ig extent in this county. The executive committee have already discovered y 1,000 head of cattle in this county alone have been exposed to the disease. own that at least sixty different persons, scattered over the county, have cattle exposed, and how much further it may have extended it is impossible til further examination is made. Every day's work of the committee in- e number of exposures. Nor are the contaminated herds confined to Fulton diate vicinity. The farther from Fulton the greater the number of exposed

ease *can* and *must* be stamped out at any cost. There is no time now to wait at your neighbor will do. Business in our county is dead. Our cattle are ed in the county. How long shall this stagnation of business remain? l you be able to ship your cattle to market? There is but one answer: you can say to the world pleuro-pneumonia no longer exists. What class ll this disease most affect? There is but one answer: The men who own est number of cattle. Why stop to argue the question that our merchants, rs, our lawyers, our smiths, and other mechanics are as much affected as the ? You know the cattlemen are vitally interested, and to the cattlemen to take steps to protect themselves.

less, it is suicidal, for the people of Callaway to remain idle and expect ities to do for them what they will not do for themselves. Whenever our ll show to the world that they realize the importance of this calamity by o money to suppress it, then will the other counties come to your help, and en. Callaway County has over $1,000,000 worth of cattle, nearly every dol- ch is liable to be lost. If your dwelling-house, worth $1,000, was on fire i not give $100 to save it? How much have the people given to save the exposed? Not $3,000; not one-third of 1 per cent.!
i see your house burn to the ground because your neighbor won't come and put out the fire? That is what the cattlemen, the business men, all the e county are doing—waiting for their neighbors to save their property. ou say, "why don't the governor call the legislature together and get the elp us?" Is the State more interested in saving your property than you one has a right to ask for help until he has tried to help himself. If Calla- ty will subscribe $15,000 to stamp out pleuro-pneumonia, we have no doubt ial amount will be furnished outside the county. One man in Kansas City y offered to give one-tenth of the whole cost, not exceeding $50,000.
ill you do? Go to work, every man of you. See your neighbor; get him be something.
to secure concert of action and to effect a more thorough organization and plans for raising money, we hereby call upon the tax-payers of Callaway he cattlemen, the mulemen, the mechanics, the merchants, the doctors, the nd every other class or profession to meet at Fulton on Saturday, April 25, ne one, come all! Come to do something! If you will come in the right word for it, in thirty days every cow in the county that has been exposed pneumonia will be in her grave. Ask your neighbor to come.

J. D. HENDERSON, *County Clerk,*
N. D. THURMOND, *Representative,*
JOHN A. MOORE, *Treasurer,*
Finance Committee for Callaway County.
C. A. BAILEY,
JOHN L. ERWIN,
SISERA THRELKELD,
Executive Committee.

The same committee addressed the following communication to the governor:

PROGRESS OF PLEURO-PNEUMONIA.

To his excellency JOHN S. MARMADUKE,
Governor of Missouri:

The undersigned executive committee, appointed March 31, at a meeting of cattlemen in Fulton, to take steps to suppress the disease of pleuro-pneumonia among the cattle of Callaway County, submit the following statement of facts, showing the extent of the disease and the rapidity with which it is spreading: The disease, so far as investigated, has been found to have originated with the asylum cattle. The asylum bought a bull last July of Mr. Tripp, near Peoria, Ill. This bull ran with the asylum herd of about 85 cattle until the herd was slaughtered in March. Of the 85 asylum cattle killed, all except 9 were found to be diseased, some slightly and others indicating that the disease was of several months' duration. The spread of the disease outside of the asylum herd can be traced almost entirely to cattle formerly owned by Isaac Owen and John Lawther, each of whose farms adjoins the asylum lands on the east, there being only a fence between the asylum pastures and these farms.

Mr. Owen owned 28 head of cattle since the appearance of the disease at the asylum, or, rather, since the Illinois bull was brought there. Of these he sold to W. F. Nesbit, 3 miles south of Fulton, 4 head, which were placed with 14 other cattle of Mr. Nesbit's. The 4 head have been all killed, and three of them found to be affected with the disease. There has been no chance, as far as we can learn, for the disease to spread to other cattle from Nesbit's herd, except to the cattle on county farm. Nesbit's cattle at one time were on a farm adjoining the county farm, which has 1 head.

Mr. Owen sold to Mr. Gallagher, 8 miles east of Fulton, 3 head which were placed with 12 others of Gallagher's cattle. The 3 purchased of Mr. Owen were examined and found diseased. All of Gallagher's 15 head have been killed.

The following cattle have been exposed to Gallagher's, all in the immediate neighborhood: Frank Smith, 5 head; Christopher, 2 head; Willis Dearing, number not known; Calicote, 2 head; James B. Smith, 2 head; Glover, 1 head; Garrett, 6 head; Lawrence, 7 head; Sigman, 8 head. Mr. Lawrence's cattle have been running out and we cannot tell how many they may have come in contact with. Nor is it yet known that any cattle that have been exposed to Gallagher's have the disease, as it is yet too early to tell.

Mr. Owen sold to Jack Muir, 5 miles north of Fulton, 3 head, which were put with 11 head of Muir's cattle, 14 head of Cook & Houf's, and 7 head of I. H. Dunham's. The 3 purchased of Owen were killed and all found diseased. The rest of Owen's herd, 18 in number, have been killed, and of 6 examined after they were killed, all were diseased.

Mr. Ballinger, a neighbor of Mr. Owen, had 2 cows that were with Mr. Owen's cattle about Christmas. They have been examined, but there could be found no indications of the disease yet.

J. L. Erwin bought a cow of Mr. Owen September 1; she was placed with Irwin's herd of about 140, was killed some time since and found not diseased.

I. H. Dunham's farm adjoins Mr. Owen on the east. Mr. Dunham had 13 head exposed to the Owen's herd, and 5 of Mr. Dunham's cattle have, upon examination, been found diseased.

Frank Massey has 2 cows and Louis Stanbaugh 4 head that have been exposed to the Dunham cattle. Mosby, Wills & Berry have 13 head exposed to Dunham's and 2 diseased. Monroe White has 1 cow that has been running with Mr. Owen's cattle. Mr. Freiberger 10 or 12 head that have been running with Mr. White's cattle. Louis Baker has 16 head that have been running with Freiberger's.

The above gives the number found to be diseased and exposed to the disease through Mr. Owen's herd.

John Lawther was trading extensively in cattle last fall and summer, and also during the winter. Yet it is not known how many cattle he had on his place that have been exposed to the asylum herd. He sold a cow to Mr. Gross, in Fulton, probably in February or March. This cow was examined by Dr. Trumbower and he pronounced her diseased. She was killed and found diseased. While Mr. Gross had her she was in a lot adjoining a lot which W. B. Tucker kept several head in The town cows running on the streets could also come in contact with her.

Mr. Lawther sold 1 cow to Mr. Herckenrath, in Fulton. So far no indications of disease. He also sold 1 cow to J. L. Erwin, 1 mile north of Fulton, on February 3. She was examined by Dr. Trumbower on the 14th instant and pronounced diseased; she was killed on the 17th and found badly diseased. This cow was with Mr. Erwin's herd of about 140, mostly milch cows.

The cow bought of Lawther had a young calf which Mr. Erwin placed with his own

ves, 22 of which were sold to Jerry Muir on March 4. Muir sold the Erwin calves Tyler.
Ir. Lawther sold to Cook & Houf, 5 miles north of Fulton, 14 head, which were with their other cattle, 50 or 60 in number. They sold some of the Lawther cat- to the asylum for beef. Several were shipped to Saint Louis, 1 sold to George ig in the neighborhood, 2 to Jerry Muir, also in the same neighborhood. The one l to Craig has been killed and found diseased, and 15 head still in Cook & Houf's session that were exposed have been condemned and will be killed. The one sold George Craig came in contact with 4 others and was in a field adjoining 40 others.
k & Houf sold 1 of the Lawther cows to George Gilmore, 7 miles north of Fulton.
awther sold 42 head to Davis & Co., which were wintered since January on T. R. W. T. Brooks's farm, 7 miles west of Fulton. J. R. Baker, 12 miles northwest of ton, bought 25 head of these cattle. Lawther also sold to Stephen Pugh, 5 miles theast of Fulton, about January 1, 12 head, now on Pugh's farm with about 20 ers.
awther sold to Hood, in Audrain County, 15 head. Hood lives south of Mexico. rther says the Hood cattle had the same chance to contract the disease as others is cattle that had been found diseased.
etrie adjoins the asylum. He had 8 head killed, and all were found diseased.
hadrick adjoins Petrie, has 1 cow, been examined, but no disease discovered as

irk adjoins Petrie, has 5 head, but no indications of disease.
ebo adjoins the asylum, and has 2 cows; examined, and 1 found diseased.
elte adjoins the asylum and Debo's place. Has 6 head; 1 found diseased.
ames Wood has 1 cow that had access to the pasture where the Illinois bull was t, and was bred to this bull. Examined, but no indications of disease found.
enry Nichols has 1 cow pastured in lot adjoining the Illinois bull lot. Examined no trace of disease found.
eff. Williamson has 18 head pastured in lot adjoining the asylum pasture. Exam- l and indications of disease found. Mr. Williamson sold to T. D. Brooks last 3 calves. Brooks lives 17 miles southwest of Fulton.
ilton Finley has 1 cow; ran on commons and was exposed to the Illinois bull. examined.
rs. Bush, 1 cow exposed as above. Not examined.
ick Davis, south of Fulton, had a steer that jumped in with asylum herd; now h W. F. Nesbit's herd.
T. B. Tucker, in Fulton, has 6 head that have been with asylum cattle.
enry Kibby, 1 cow running on commons about town, supposed for some time to e been diseased. Killed a few days since and found to have been diseased and ented a case of recovery.
. M. Herndon, in Fulton, had 1 cow bred to the old asylum bull six or seven nths since. Killed and badly diseased. This cow was taken to farm, 2 miles th of Fulton, and ran in a field to herself. Fisher's cattle across the public road n her. Cattle running out may have been exposed to her.
esse Darby, 12 miles west of Fulton, bought 2 or 3 calves from the asylum last ; no examination made yet.
r. McSchooler, 5 miles north of Jefferson City, bought bull calf from asylum last ember. Calf died March 1 with symptoms indicating the disease.
ohn Brown, of Audrain, bought on the 2d of March, at Fulton stock sales, about head of cattle, sold by Hyten Bros., who lived 10 miles southwest of Fulton. y were taken to Brown's farm in Audrain. It is not known that they had any nce to contract the disease. The only circumstance connected with this herd is fact that they were in Fulton, where it is known that the disease does exist, but s not known that they came in contact with diseased animals.
. N. Dutton, of Readsville, 16 miles east of Fulton, and only 2 or 3 miles from ntgomery County line, bought 5 head from Jerry Muir and placed them with 9 his other cattle on his farm. It is claimed that these cattle have never been ex- ed. We do not know.
oe Holmes, 7 miles south of Fulton, bought a calf of Hugget, at asylum. Cow ce died with strong probability that she had disease.
. W. Roberts, 5 miles northeast of Fulton, bought 4 head from Jack Muir on rch 1, and placed them with his other cattle.
Benjamin Scroggins, south of town, has 1 cow that ran out and was exposed to Illinois bull last fall.

committee have killed to date the following cattle: Owens 18, Craig 1, Nesbit k Muir 3, Gross 1, Kibby 1, Gallagher 15, Petrie 8, McSchooler 1, Herndon 1, . Cook & Houf 2—total, 55. This does not include asylum herd of 85, killed nagers.

in Fulton, as shown by the assessment, 198 head of cows; 38 of them have d by Dr. Trumbower, and 4 out of the 38 were found diseased. These

animals have been running at large during the whole winter, and it is impossible say how many others they may have infected.

There have been stock sales in Fulton on the first Monday in each month for s eral years past. On some days probably 200 or 300 head of cattle were sold, and c ried to different and remote parts of the county, and many of them to adjoini counties. We cannot tell whether the disease was taken with them or not; we si ply give the possibilities.

The committee finds at least fifty to sixty persons who have had their cattle e posed, not counting the individual exposures in Fulton. Some of these have o from 1 to 6 head. Others own from 10 to 50 head. We find to date about 1,000 have been exposed directly or indirectly, and our work of discovery is not ye plete. We shall continue our investigations, and hope in another week to m much fuller and more accurate report than this.

WHAT SHALL BE DONE?

We have had no trouble to induce parties to have their cattle killed when w the money to pay for them. But our means have been very limited. So far al money at our disposal was the amount raised at our first meeting—about $2,600, wi only about $1,400 paid in. It is our object now to ascertain the extent of exposu so as to estimate the probable amount necessary to suppress the disease. We sh do all in our power to suppress the disease, but if a stronger power than individu effort does not interpose, how long will it remain suppressed?

The stables and pastures where the diseased animals have been running shou quarantined, as it were, for a year. There ought to be some law that will comp owners of such stables and pastures not to allow cattle to be put in them for s a year.

The county finance committee appointed by the State finance committee, of you are chairman, has called a meeting of the citizens of this county to meet a ton on the 25th for the purpose of raising money. What the outcome will be w not tell.

The spread of the disease is simply appalling. It can be more easily suppress hereafter. If it is not suppressed who will be responsible? Let our State aut answer.

Believing that you, as the chief executive of the State, are fully alive to the gr interest at stake, and that you feel the great responsibility, and will do all you c to deliver the people from the effects of this sad calamity, we remain,

Respectfully, your most obedient servants,

C. A. BAILEY,
J. L. ERWIN,
SISERA THRELKELD,
Executive Committee.

FULTON, *April* 20, 1885.

In answer to a telegram Dr. Trumbower telegraphed, on April that cattle were being driven out of Callaway and shipped in ad counties, and that railroad agents in this (Callaway) County, outs Fulton, received cattle for shipment. The following notice was fore sent to the vice-president of the Missouri Pacific Railroad, and similar one to the president of the Chicago and Alton and to the eral manager of the St. Louis and Pacific Railroad:

DEPARTMENT OF AGRICULTURE,
BUREAU OF ANIMAL INDUSTRY,
Washington, April 20,

SIR: I have just been informed by Drs. Michener and Trumbower, inspector Bureau of Animal Industry, that cattle which may have been exposed to pleu monia are being shipped by rail from various stations in Callaway County, and also being driven for shipment to stations in the adjoining counties of Boone, Montgomery, Cole, and Osage.

In this connection I would call your attention to sections 6 and 7 of the act e lishing the Bureau of Animal Industry, which provides a penalty for receiving animals for shipment. Considering the great danger to the whole cattle ind the country from this disease, will you not prohibit shipments of cattle from s in the counties above named, except when accompanied by certificates of from our inspectors? Answer.

NORMAN J. COLMAN,
Commissioner of Agriculture.

R. S. HAYES, Esq.,
First Vice-President Missouri Pacific Railroad, Saint Louis, Mo.

o many animals had been exposed to the contagion, and there was h imminent danger of the infection of other States, and even of the ges of the Territories, while the restrictions on interstate commerce mised to become a source of even greater loss, it was deemed very ›le from a national point of view to use every possible means of mping out the disease at once and thoroughly. On consideration it ›eared that the animal industry law might be so construed as to ›w the use of the unexpended part of the appropriation for the slaugh- of diseased or exposed animals, providing this was considered as an of disinfection. Accordingly a letter of inquiry was addressed to Attorney-General of the United States as follows:

DEPARTMENT OF AGRICULTURE,
BUREAU OF ANIMAL INDUSTRY,
Washington, D. C., April 18, 1885.

IR: I desire to call your attention to the act establishing the Bureau of Animal ustry, approved May 29, 1884, and to ask your opinion as to the proper construc- ı to be given the words "and in such disinfection and quarantine measures as may necessary to prevent the spread of the disease from one State or Territory into ther," which may be found just preceding the close of the third section. The law ı the result of a demand for a measure for the suppression of the contagious pleuro- umonia of cattle, and while other infectious and contagious diseases of domestic mals were included among those to be investigated and suppressed, that of con- ious pleuro-pneumonia was regarded as of paramount importance. As this disease ıcurable, and the only way of suppressing it is by the slaughter of diseased and ›cted animals, I desire to know if, in the sense in which the word "disinfection" sed in the law, I am not authorized to purchase diseased and infected animals for urpose of slaughter, *i. e.*, "disinfection."

› veterinary profession the world over unites in recommending the slaughter of ls affected with pleuro-pneumonia as the most essential, in fact the indispen- ıe, measure of disinfection for this disease, and this view is now accepted and upon by the leading nations of Europe, including Great Britain, Germany, ıand, Belgium, Switzerland and France.

n early reply is requested.

Very respectfully,

NORMAN J. COLMAN,
Commissioner.

lon. A. H. GARLAND,
Attorney-General.

The reply to this letter is given below:

DEPARTMENT OF JUSTICE,
Washington, April 21, 1885.

IR: Yours of the 18th instant calls attention to the act of 1884, chapter 60, en- ed, "To provide means for the suppression and extirpation of pleuro-pneumonia," , and, referring particularly to words giving you power to expend money "in h disinfection and quarantine measures as may be necessary to prevent the spread isease from one State or Territory into another," asks whether by these words you not "authorized to purchase diseased and infected animals for the purpose of ıghter *i. e.*, disinfection."

t the same time you state that the destruction of animals infected with pleuro- umonia is recognized by experts as the only way of putting a stop to the spread that disease.

onceding that this opinion exists and is well founded, I nevertheless think that statute in question does not confer power to purchase and slaughter such animals. ou will observe that the statute makes distinction betwixt the District of Colum- and other parts of the country, as regards the duties which it assigns to United tes officials. In the former case only are such officials expressly directed "to re- › the destruction of infected animals." The officials so empowered are not even t case such as belong to the Department of Agriculture. They are Commis- ıs of the District; or in other words the local authorities, such as answer to the ve authorities of the States. For the destruction of infected animals within ict, therefore, a co-operation is provided between its legislature (viz., Con- statute in question affording such co-operation), and the local executive. standing is, that the same co-operation is intended also where such animals be destroyed elsewhere. And I add that inasmuch as Congress has not pro-

vided for "purchase" of those animals within the District, I presume the more th it does not intend the appropriation contained in the act so to be applied anywhe The diseased animal, as in ordinary cases, *peril suo domino*, the hastening of suc event upon public grounds, being, to all appearance, supposed by Congress to affor no ground for setting up a market for such animal, wherein the public is to be pu chaser.

The act in question being, as probably was anticipated, the first of a series upo that subject, is consequently somewhat general and merely tentative in its provisions as, for instance, was the case in analogous recent legislation establishing a Nation Board of Health. As the results of experience and observation accumulate upo the topic of which you speak, no doubt more definite legislation is intended.

Section 3, to which you refer, authorizes the regulations by the Commissioner Agriculture, and supposes that these may be adopted by State executive authoritie or, as an alternative, supposes regulations by State executive authorities which i turn it empowers the Commissioner to adopt. In either case of course such Stat executive action is to be authorized by competent State legislation. The section the proceeds to suppose a time for action to arrive, and to be notified by some prope State authority to the Commissioner. And thereupon the Commissioner is autho ized, as you quote, to spend money for the quarantine action required by the parti ular exigency.

There is, however, as I repeat, no provisions for purchasing the diseased animal The question, at whose loss any necessary destruction of these may be, is not a que tion of quarantine, and the powers of the Commissioner are incident to quarantin only; it being important, of course, that for the purpose of executing these he shal have acquired information and come to conclusions in the way indicated by section

Very respectfully,

A. H. GARLAND,
Attorney-General.

The COMMISSIONER OF AGRICULTURE.

A similar letter to that of the Commissioner of the 18th of April t the Attorney-General was forwarded to the First Comptroller of th Treasury, and was promptly replied to as follows:

TREASURY DEPARTMENT,
FIRST COMPTROLLER'S OFFICE,
Washington, D. C., April 21, 1885.

SIR: In reply to your request asking my construction of the act of May 29, 188 "for the establishment of a Bureau of Animal Industry," and especially that portio of the same giving you the authority to expend the amount appropriated as is em braced in the following words, "And in such disinfection and quarantine measures a may be necessary to prevent the spread of the disease from one State or Territor into another," I have to state:

The power given to the Commissioner by said act seems to be broad and unlimite as to the means to be used by him to carry out said disinfection and quarantine, an it is my opinion that he can cause such investigation to be made in regard to th matters mentioned in said act as he may deem proper, and then use such means as h deems best to carry out the objects and purposes of the same. If he regards th slaughter of the infected animals necessary to carry out such objects and purposes h may do so, but he cannot expend any more than the amount appropriated under an state of the case. He must keep himself within the limits of said appropriation i carrying out said act.

Very respectfully,

M. J. DURHAM,
Comptroller.

Hon. NORMAN J. COLMAN,
Commissioner of Agriculture.

On the 23d day of the same month the following additional letter wa received from the First Comptroller:

TREASURY DEPARTMENT,
FIRST COMPTROLLER'S OFFI
Washington, D. C., April 2..

SIR: I have just received a note from the Attorney-General stating that he written you an opinion as to your powers under the pleuro-pneumonia act ad the one that I had given you.

In that note he refers to the unofficial interview he and I had, but he concludes,

n a more thorough examination of the whole case, that perhaps the off-hand opin-
he gave me was incorrect.
am still of the same opinion as I was when writing to you, but perhaps for greater
tion you had better act upon the opinion given by him, as he is a higher officer of
Government than myself.
deem this explanation necessary to both the Attorney-General and myself, as I
l to you that I had consulted him privately about the matter, and that is the rea-
why he addresses me as he has done to-day, to-wit, that he had changed his mind
n a more thorough investigation of the whole act.

Very respectfully,

M. J. DURHAM,
Comptroller.

lon. NORMAN J. COLMAN,
Commissioner of Agriculture.

On the receipt of the Comptroller's letter of April 21, rules and reg-
tions for the extermination of the infected herds in co-operation with
State authorities were telegraphed to Governor Marmaduke and
re accepted by him. The opinion of the Attorney-General and the
ond letter of the Comptroller, however, made it necessary to with-
r such of the regulations as made it obligatory for the Department
p for slaughtered animals.

To guard against the shipment of infected cattle the following notice
s inserted in the newspapers published in the locality where the dis-
existed:

TICE IN REGARD TO CONTAGIOUS PLEURO-PNEUMONIA IN CALLAWAY COUNTY, MISSOURI.

DEPARTMENT OF AGRICULTURE,
BUREAU OF ANIMAL INDUSTRY,
Washington, D. C., April 20, 1885.

n accordance with section 7 of an act establishing the Bureau of Animal Industry,
ereby give notice that contagious pleuro-pneumonia exists among certain herds of
in Callaway County, Missouri. Having been informed that parties are driving
shipping cattle that have been exposed to the contagion of this disease I desire
l the attention of all interested persons to the following sections of the law, and
e that every effort will be made to strictly enforce the provisions of these sec-

. 6. That no railroad company within the United States, or the owners or mas-
of any steam or sailing or other vessel or boat, shall receive for transportation
ransport from one State or Territory to another, or from any State into the Dis-
t of Columbia, or from the District into any State, any live stock affected with any
tagious, infectious, or communicable disease, and especially the disease known as
uro-pneumonia; nor shall any person, company, or corporation deliver for such
nsportation to any railroad company, or master or owner of any boat or vessel, any
e stock, knowing them to be affected with any contagious, infectious, or communi-
le disease; nor shall any person, company, or corporation drive on foot or trans-
t in private conveyance from one State or Territory to another, or from any State
o the District of Columbia, or from the District into any State, any live stock, know-
them to be affected with any contagious, infectious, or communicable disease, and
ecially the disease known as pleuro-pneumonia: *Provided*, That the so-called sple-
or Texas fever shall not be considered a contagious, infectious, or communicable
ease within the meaning of sections 4, 5, 6, and 7 of this act, as to cattle being
nsported by rail to market for slaughter, when the same are unloaded only to be
l and watered in lots on the way thereto.

SEC. 7. That it shall be the duty of the Commissioner of Agriculture to notify, in
iting, the proper officials or agents of any railroad, steamboat, or other transporta-
n company doing business in or through any infected locality, and by publication
such newspapers as he may select, of the existence of said contagion; and any per-
n or persons operating any such railroad, or master or owner of any boat or vessel,
owner or custodian of or person having control over such cattle or other live stock
in such infected district, who shall knowingly violate the provisions of section 6
act, shall be guilty of a misdemeanor, and upon conviction shall be punished
ne of not less than $100 nor more than $5,000, or by imprisonment for not more
ne year, or by both such fine and imprisonment.

NORMAN J. COLMAN,
Commissioner of Agriculture.

The following reply to inquiries of Dr. Trumbower is of interest i this connection:

DEPARTMENT OF AGRICULTURE,
BUREAU OF ANIMAL INDUSTRY,
Washington, D. C., April 25, 1885.

This Department has no authority to appoint sub-agents such as you refer to. asked the railroad companies to refuse cattle offered for shipment from the suspecte counties unless accompanied by a certificate of health from you. This plan would r quire no additional force, and is the only one practical. When owners resist inspe tion we have no power to enforce it. Can only depend on State law for power to i spect and quarantine. Parties shipping affected cattle into another State are the ones subject to the penalties of our law. The Attorney-General decides that we not pay for slaughtered animals.

NORMAN J. COLMAN,
Commissioner.

Dr. M. R. TRUMBOWER,
Fulton, Mo.

As the movement of cattle from Missouri through Kansas City to th Western States was almost completely suspended by local restric and as many requests were received for an inspector at Kans who could grant certificates of health and to allow the trade in cattle to be resumed, Dr. Trumbower was stationed at Kansas City perform this duty. Dr. C. B. Michener, who had been for some time Fulton assisting Dr. Trumbower, was left in charge at that point.

The following document, issued by the secretary of the Missouri board of agriculture, is of interest in this connection:

MISSOURI'S DISTRESS AND DANGER.

OFFICE OF SECRETARY,
MISSOURI STATE BOARD OF AGRICULTURE,
Columbia, Mo., May 1, 1885.

We, the undersigned executive committee of the State board of agriculture, d hereby authorize the secretary of the board, J. W. Sanborn, to organize ways a means to raise money and dispose of it in such manner as will contribute to stam out the cattle disease now so prevalent in Callaway County, this State, and report this committee from time to time.

JOHN WALKER.
H. ESBAUGH.
J. W. SANBORN.

Under the action thus taken the secretary received from his excellency, John S. Ma maduke, the following indorsement by telegram, namely:

"Yours of yesterday received. I heartily indorse and commend the plan adopte by the executive committee of the board of agriculture. The State treasurer is a just now, but I will vouch for his acceptance of the trust. Make your arrangem carefully that no error or confusion may embarrass the enterprise, and push it ra and with vigor. Now let us quit talking about an extra session and give our a tion to raising this money immediately, and as fast as it is received it will be use extirpating the disease.

JOHN S. MARMADUKE."

That this action of the board of agriculture, through its executive commit not seem presumptuous, it may be stated that the board is the only official c tion for the promotion of agriculture in the State. By official we mean holdin missions from the governor and founded in the laws of the State. That its chara may be known its membership is given:

Ex-officio members.—John S. Marmaduke, governor of Missouri; W. E. Coles superintendent of public instruction; S. S. Laws, LL. D., president of Universit Missouri; J. W. Sanborn, dean of agricultural college.

Commissioned members.—Hon. John Walker, Jefferson City, Cole County; Hon. N. J Colman, Saint Louis; Hon. H. Esbaugh, Hanover, Jefferson County; C. E. Leo esq., Bell Air, Cooper County; J. A. Potts, esq., Mexico, Audrain County; W. M. esq., Walker's Station, Vernon County; M. Fairchild Doud, esq., Kansas City; R. Rippey, Glenwood, Adair County.

It properly falls within the duty of the above organization to act in t

he above names and the plan to be hereafter outlined will, it is believed, com-
. the enterprise.
nay be proper to state that so long as there was a pressure for an extra session
› legislature it was thought useless to act in the capacity now assumed, but now
it is definitely known that no extra session will be called, all can unite upon one
upon which complete success, it is now believed, may be achieved.

THE NEED OF ACTION.

preceding facts were arranged for publication, with other matter, when the ex-
at regarding pleuro-pneumonia was at its highest in the State, but just at the
ction of this article, the State veterinarian, Dr. Paul Paquin, reported that the
se was confined to an area of 10 miles from Fulton, and that it was "virtually
pated." Since then, in a statement directed to me as dean of the agricultural
ge, Dr. Michener, United States veterinarian stationed at Fulton, of high repu-
n as a veterinarian, repeats the assuring words, and says that not an acute case
s in his belief, in Callaway County, and none has appeared beyond 12 miles from
, yet he advises raising $10,000.

WHY NOW RAISE MONEY?

cause history in no department of human affairs has shown more clearly a neces-
than the one now before us. The most insidious of all diseases is within our
rs, whose insidious character, the bulletin No. 15, recently issued from the agri-
ral college, and now before most of those who will receive this, shows:
It is months, often, that an animal is affected with the disease, and to untaught
is not noticed, and yet the animal may be imparting the disease to others.
The animal apparently gets well, yet its lungs contain the disease and impart
ers. The cow that went to Australia and gave the disease that swept away
00 of stock was an apparently recovered case. Massachusetts believed she
of it only to find it burst forth fifteen months after. Illinois is now startled
reappearance at Peoria, seven months after she believed she was clear of it.
, during the last week, again reports it where it had slept for months un-
s is its history. Callaway County and its veterinarians report no visible case,
g killed over 220 animals. But the veterinarians each send out a warning, and
im of $10,000 is named as necessary for any lurking cases, for it is not the sick
re alone to be killed, but every infected herd must go. Illinois and Kentucky
inst learned that they should have killed the herd and not merely the sick ones,
the balance as hidden breeding grounds and centers of propagation months

n let the mistakes and experience of others be our warning. Let us, like men,
ided by the history of the past, and not by animal carcasses in the future, and
ps too late. Indeed, now is the critical time for completing the work, and yet
ndency is to go to sleep on the question. There are several herds in which the
e may appear, near to Fulton, whose value may reach $10,000, and whose pur-
Callaway County farmers say they cannot and ought not to make. They ought
be asked to. Why? Because the disease involves the interests of the whole
Feeding the fears of other States, whose interests this dangerous disease
tens, our State is girdled on three sides with a quarantine that has brought a
ercial night upon our stock commerce and threatens a paralysis of all business
Missouri.
resenting $70,000,000 to $80,000,000, our cattle industry forms one of the largest
ost profitable of the resources of the State. The mercantile business of every
nd village draws life from it; the banks of every community are involved in its
erity, and the labor of every town and the sustenance of most farmers are di-
involved in its welfare. With one of the best soils, climate, and location for
ers of fine stock, Missouri has become among the first of States in reputation for
herds and is now or was a great purchasing ground for breeders for the vast
the plains. That business is almost completely strangled by the quarantine
as shut down around us. Herds that two months ago were worth $20,000 are
-day salable for $10,000, yet they are only tainted by association and not by dis-
The tenacity with which this disease clings to the skirts of our sister States
as with no uncertain sound that unless we act upon the theory that this disease
mbering we shall leave it as a patrimony to our sons and their sons to the
fourth generation, and at last stab fatally the nation's export trade in live
sacrificing thereby the most hopeful feature of our agriculture and the corner-
the highest type of farming.
y lurk for millions, but cash down will take thousands; it demands
can be now put off with months; it asks every county, but may be put

terest is not to quarantine well stock and paralyze trade, have pronounc
pneumonia, and the consequent quarantine has actually driven land buye
State, affected the value of land in the affected area, if not over the St
preciated the valne of our herds of the whole State; brings several teleg
office every day from distant sections of the State for professional aid, tha
may be shipped to the beef markets, and the owners are now convinced
not dealing with a local question, as some would make it and not aid in
We are not fighting a man of straw, but a terrible demon that may still
in the one unfortunate county.

Gentlemen, the suspicion that this incubus is upon us must be lifted off
and no one in the State will be denied his clear right to aid with his m
purely a business question. We have got to satisfy the world on this p
quicker the better, for now is the most opportune time, for the disease is
the vigor and skill of a few citizens of Callaway County. Its area of
confined within 12 miles of Fulton. It is under the power of two quara
the State and the right by law to kill. It is so controlled that one at leas
troublesome quarantines against us is under consideration and likely t
We are to have no session of the general assembly; Callaway County sho
cannot be expected to meet the possible danger, and we should not ask
the load alone. It is necessary to do this work to satisfy other States,
there had been no disease in the State we could well afford to raise half
satisfy these States.

CONDITIONS OF DONATION.

(1) His excellency, John S. Marmaduke, promises to recommend the
assembly to repay these sums contributed, and in this matter is sustain
members likely to return.

(2) All the counties will be asked to aid and may become interested
donors.

(3) All donations to be daily published by the treasurer in one or mor
dailies, as received, that no question may arise as to what becomes of the

(4) The State treasurer is to receive directly all money donated, and p
except upon vouchers, each voucher giving a narrative of the case o
money is paid, the governor, auditor, and attorney-general as a committ
said vouchers, thus having right at hand in the treasurer's office all th
vouchers for the same to present as a whole to the general assembly.

(5) Any money not expended will of course be returned *pro rata*.

(6) All cattle killed are to be appraised by three farmers at a rate le
market value or on a basis of two-thirds valuation. The committee is or
is indorsed by Governor Marmaduke, and is the same that has done the
thus far.

(7) The State veterinarian, who is connected with the agricultural col
at the command of the authorities, and no cattle will be killed withou
Government veterinarian's inspection and certification of disease.

A PERSONAL QUESTION.

Please to remember that this move is indorsed by the governor, is in
with a vote taken by a meeting of eminent gentlemen at Mexico on May 7,
Ex-Governor Hardin presided, is said to be necessary by the veterinaria
aid in placing us right before the world; that the move is not an idle or nar
that the money must and will be had, and that it is you who ought to assi

following letter, sent in reply to a telegram received from the ernor of Illinois, gives a condensed summary of the measures in e in Missouri to suppress the disease:

DEPARTMENT OF AGRICULTURE,
BUREAU OF ANIMAL INDUSTRY,
Washington, D. C., May 5, 1885.

R: In reply to your telegram of this date, asking for the regulations of the De ment of Agriculture in regard to the quarantine of pleuro-pneumonia in Call County, Missouri, I beg to state that the railroad companies which have stations allaway and adjoining counties have been notified not to receive any affected cat- or shipment to other States under the penalty prescribed in sections 6 and 7 of the ablishing the Bureau of Animal Industry. Notices of the existence of the dis- ave also been published in the local papers, and the attention of the public d to the penalties for such shipment of cattle. In addition to this the railroad panies have issued regulations prohibiting the shipment of cattle from these coun- unless accompanied by a clean bill of health from our inspectors. Our inspectors loing all in their power to locate infected herds and to prevent the shipment of rous animals.

Very respectfully,

NORMAN J. COLMAN,
Commissioner.

on. R. J. OGLESBY,
Governor of Illinois, Springfield, Ill.

n reply to a request from the Kansas sanitary commission for Dr. mbower to act as inspector for Kansas, in addition to his duties for Department, the commission were informed that Dr. Trumbower ld gladly examine any suspected cattle in the vicinity and give any rmation or assistance to the commission which might be in his power which would not interfere with the work assigned him by this De- tment. Dr. Trumbower was informed at the same time that he might st the Kansas authorities while stationed at Kansas City, but that Department could not permit him to accept an appointment which t interfere with the work for which he was stationed there.

. Michener was called home by private business about June 15. there had been no case of pleuro-pneumonia among exposed cattle nearly two months, and as a State veterinarian had been appointed ook after local interests, it was not considered necessary to keep an pector constantly stationed at Fulton after that time. In the follow- letter Dr. Trumbower was directed to make a final inspection and ort results:

DEPARTMENT OF AGRICULTURE,
BUREAU OF ANIMAL INDUSTRY,
Washington, D. C., July 13, 1885.

R: On receipt of this you will please go at once to Fulton and make a thorough ection of all suspected herds in that vicinity and report their condition and the bability of any further cases of disease. You will also note the time when the last cted animal was destroyed in any herds reported upon, and state if, in your judg- t, there is any further necessity of maintaining the restrictions upon shipments Missouri cattle. Cannot trade go on as usual through Kansas City, without an in- ctor being stationed there from this time onward?

Very respectfully,

D. E. SALMON,
Chief of Bureau.

r. M. R. TRUMBOWER,
Kansas City, Mo.

To this letter the following reply was received:

FULTON, MO., *August* 1, 1885.

to find any further evidence of disease among the cattle here. The last af- was killed April 18.

M. R. TRUMBOWER,
Inspector.

Dr. D. E. SALMON,
Washington, D. C.

Nearly three and one-half months having elapsed since the destruction of the last affected animal, it was now considered safe to withdraw the inspector of the Bureau. The State veterinarian has since kept up a supervision of this district, but no other cases of pleuro-pneumonia have developed. The disease was, therefore, stamped out, and in a very much shorter time than most people considered possible. For this happy result we are very much indebted to the active co-operation of the railroad companies doing business in that part of the State, and to the vigorous measures adopted and carried out by the citizens.

Dr. Trumbower's report, which contains many facts and details of work not mentioned above, will be published in full in the Second Annual Report of the Bureau of Animal Industry.

OHIO.

There have been no animals affected with pleuro-pneumonia in Ohio, according to the most authentic information at our command, since September, 1884. In the herd of Mr. C. R. C. Dye, from which the disease was disseminated throughout the Western States, there have been no cases for more than eighteen months. It is believed that the contagion has been entirely extirpated from this State, and that there will be no new cases of the disease until there is a fresh importation of the contagion. There have been appointed in this State a board of cattle commissioners and a State veterinarian, who have made frequent inspections of the infected herds. They have shown a desire to co-operate with the Bureau of Animal Industry, and in case of any fresh outbreak there is no doubt that we would have the assistance of the State authorities.

ILLINOIS.

The following is a summary of a report made to the Chief of this Bureau by Dr. N. H. Paaren, State veterinarian, under instructions of the live stock commission of Illinois: March 2, 1885, 4 cows and 1 bull were condemned and killed, being all that remained of the Clarke herd at Geneva. Three cows showed unmistakable signs of having been diseased, the lungs adhering to the diaphragm and ribs, and one lung in each cow having encysted portions evidently of very long standing. On the 10th of March the State veterinarian was called to the farm of F. H. Bowron, located directly across the river from the Clarke farm, near Geneva, and was shown the lungs of 2 cows that had died of a disease that was afterwards suspected to be contagious pleuro-pneumonia. The lungs were not in a good condition for examination, but their appearance was such that the farm was quarantined, there being kept upon it 51 head of dairy cows of native and mixed breeds. On May 2 another visit was made to this farm and a cow found in the last s of pleuro-pneumonia. She was condemned and killed. *P* r examination revealed extensive adhesions of both lungs, which were torn in removing them from the ribs and diaphragm. All except the anterior lobes of both lungs was diseased, each lung weighing between 25 and 30 pounds. There have been no new cases on this farm nor in Kane County since that time. On the 23d of April the State veterinarian condemned and killed all the animals on Mr. Bailey's farm, near Peoria, which had been exposed, with the exception of 1 cow; in all, 5 head. This included 3 diseased animals. The remaining cow subsequently contracted the disease and was killed about two weeks later. These cows included all the animals attacked with pleuro-pneumonia during the year 1885.

›tember 15 I visited the herd of Mr. John Boyd, of Elmhurst, e request of the State live stock sanitary commission. I found › cows which had been isolated because it was supposed they ı affected with pleuro-pneumonia in a mild form. In two of ould find no evidence of lung disease by auscultation and per- in a third there was only crepitation and slight loss of reso- er a small portion of the right lung. In the two remaining ones s greater dullness on percussion and a decrease in the normal f respiration at the same point, but even with these there were positive indications of serious lung disease. In examining the cows among which no symptoms of disease had ever been no- e animal was found with loss of respiratory sounds and dullness ›art of the right lung. With this animal the signs of lung ere more positive than with either of those which had been ly isolated. The animal was removed from the herd and placed se referred to above as suspicious animals. The third animal to was unthrifty, and was believed to be suffering from tuber- hough no positive signs of this disease were discovered. The terwards concluded to slaughter her, which was done in the of the Chief of this Bureau November 19. The *post mortem* hat the only lesion of the lungs of old standing that could be t was the adhesion of the posterior portion of the right lung stal pleura. There was some congestion of the anterior part of with a number of collapsed lobules, but no encysted portions te a former serious attack of lung plague.

time of my visit, in September, I was requested by the sanitary on to take charge of the quarantine of this herd, and was as- he co-operation of the State authorities to make this quarantine

It was believed that such a quarantine, maintained under national and State laws, would give better satisfaction to the es of the other States and relieve the cattle trade of Illinois restrictions that had been placed upon it. As it was nearly a e any of these animals had shown symptoms of the acute dis- as the evidence of the lesions at the time of the examination ght, it was believed that a quarantine maintained until a period en months had elapsed since the last symptoms were observed sufficient to prevent any danger of future outbreaks. By my ndation Dr. A. H. Baker, of Chicago, was appointed to visit at short intervals and examine the isolated animals in order to n that no symptoms showed an extension of the disease during the animals were held in quarantine. These animals have all ıg well since they have been under our supervision, and there son to suppose that there will be any further cases of lung ı this farm. Indeed, the period of quarantine has already been ›bly longer than is usually required in such cases. Since there instances where pleuro-pneumonia has been disseminated by an teen months after it has shown symptoms of the acute disease, cided to extend the period of quarantine in this case to eight- hs after the last symptoms of this nature had been seen.

VIRGINIA AND WEST VIRGINIA.

1885, Messrs. Timberlake & Maslin, of Middletown, Va., sent nication to the Department of Agriculture stating that 2 of in a herd of 6 were taken July 1 with an unknown disease ›posed to be pleuro-pneumonia, and they asked that an in-

vestigation be made to determine the nature of the affection. Dr. H. W. Rowland was ordered to make an investigation at this place. On the 18th of July he reported that the animals were affected with pleuro-pneumonia, but that he had not been able to make a *post mortem* examination in order to verify his diagnosis. This herd was afterwards examined by Dr. Rose and the *post mortem* examination showed the disease to be contagious pleuro-pneumonia. He reported that Charles Hardesty, a cattle dealer, of Summit Point, W. Va., had brought cattle there from Chicago and from Baltimore, and that a number of animals in the vicinity of Summit Point showed symptoms of lung disease, and had a cough which resembled that heard in cases of pleuro-pneumonia. The attack, however, was in all cases very mild, and the animals seem to have entirely recovered from it. Several inspections have since been made of the cattle at Summit Point, W. Va., and of those at Middletown, Va., which were infected by cattle from Summit Point, but no further cases of the disease have occurred, and it is believed that the contagion in that vicinity has entirely died out from natural causes.

Inspections made at Arlington, Va., in January, 1885, discovered 1 herd affected with pleuro-pneumonia at that place, and a partial inspection of the herds in the vicinity of Alexandria and Mount Vernon revealed 6 herds which either contained affected animals or in which the disease had recently existed. There are no laws in this State which enable the local authorities to co-operate with this Bureau to prevent the movement of diseased or exposed animals within the State.

DELAWARE.

In the First Annual Report of the Bureau of Animal Industry (p. 448) reference was made to an outbreak of contagious pleuro-pneumonia in Delaware. The State law bearing upon this subject was printed in full, together with the correspondence between the Commissioner of Agriculture and the governor of Delaware, arranging the preliminaries of a plan of co-operation. Dr. Ward B. Rowland was appointed State veterinarian by the governor, and Drs. William B. Miller and C. K. Dyer, inspectors of this Bureau, were detailed to assist in making an inspection of the suspected herds. Our inspectors remained in the State about ten days and found 3 herds in which pleuro-pneumonia existed, and in these herds there were 42 affected animals. All these herds were placed in quarantine by the State veterinarian and held until May 18, when the appropriation was exhausted and the animals released. At that time 13 infected herds were in quarantine. The following letter, which explains itself, was addressed by me to Dr. Rowland in June:

DEPARTMENT OF AGRICULTURE,
BUREAU OF ANIMAL INDUSTRY,
Washington, D. C., June 25, 1885.

SIR: I have been informed by the Pennsylvania authorities that they are apprehensive of the shipment of cattle of infected herds from Delaware to Pennsylvania. In reference to this subject I would like to inquire if the law of Delaware is such that you could be appointed an inspector of the Bureau of Animal Industry and at the same time hold your position as veterinarian of Delaware. In that case would the governor be willing to have you act in both capacities, and would he sustain you in holding suspected herds in quarantine under the State law until the meeting of the next Congress, when it is hoped measures will be adopted for the suppression of the disease? Would you accept an appointment from this Department at a salary of $5 a day and actual necessary expenses for the days on which you are employed at Department work, and devote a sufficient part of the time to this work to keep us well in-

ned as to the extent of the disease in your State? If this suggestion meets with approval, I would be glad to have you consult with the governor and to hear conclusion at an early day.

Very respectfully,

D. E. SALMON,
Chief of Bureau.

r. WARD B. ROWLAND,
Wilmington, Del.

On July 10 Dr. Rowland addressed me a letter inclosing a communi- n from Governor Stockley, authorizing him to accept an appoint- from this Bureau, and to hold the infected herds in quarantine, ng such action was without expense to the State of Delaware. ly 29 the appointment was sent to Dr. Rowland to act as an inspector this Bureau, in accordance with the plan outlined above. He was ructed to put the infected herds in strict quarantine, according to State laws, and prevent any movement of infected cattle within State, and especially from Delaware into any other State; also to e an inspection of the county or counties infected with the disease, to report weekly to this Bureau the results of his inspection.

Since his appointment Dr. Rowland has reported the existence of nfected herds, containing 184 head of cattle, 33 of which were visibly ed with pleuro-pneumonia.

In October, 1885, Dr. Rose, an inspector of this Bureau, was directed make an investigation in regard to the condition of the herds then ld in quarantine. He reported that the animals exposed to the con- gion had been inoculated, and that the herds were then held in quaran- e. The herd belonging to the Lobdell Car Wheel Company contained heifers and young steers which were inoculated in March. There re 3 cows not inoculated, belonging to a neighbor, which gained en- e into the field with the infected cattle, and were quarantined with A number of these animals had a cough, which was most marked 2 of the cows which had not been inoculated. The herd of and Frank McCauley contained 19 head of cows and young stock, which were 2 convalescent or chronic cases. This herd had been inoculated, and it was asserted that no new cases had devel- d since the operation had been performed. The herd of George hite contained 18 cows, among which were 2 animals in the chronic ge of the disease. These animals had not been inoculated, and were substantially the same condition as the animals in the inoculated rds. The herd of the Edgemoor Iron Company contained 46 head ich had been inoculated, 9 of which had not been inoculated, and convalescent cases. A great many of these animals were coughing. l of the acute cases on this and the other farms had been purchased d destroyed by order of the governor. The herd of John Banks ntained 14 animals, with which was 1 animal in the chronic stage of disease. This herd had been inoculated, but the inoculation did t "take" in any of them. They remained free from local lesions d constitutional symptoms. No new cases of the disease have de- loped since the inoculation was practiced. John Boyd's herd consisted 7 inoculated animals, of which 1 had been affected with pleuro-pneu- a. Elis Hick's herd consisted of 18 inoculated animals and 5 which been through the disease. Nicholas Garrett had 16 inoculated d 1 which had been sick. In regard to these herds no fur- ticulars are given. Some herds in other parts of the State re been infected were disposed of by the slaughter of the sick s, on the order of the governor, and the sale of those in health, slaughtered for food. Dr. Rowland believes that he has traced

most of the outbreaks in Delaware to infected animals brought from Baltimore. It is to be noted, however, that cows are frequently taken to this part of Delaware from Chester and Lancaster Counties, Pennsylvania, where there have recently been affected herds. Dr. Rose 40 cows which had been driven from these counties to Wilming on the day of his visit, which were sold there. It should also be ob ed that the supervision in none of these cases has been so rigorous o prevent new stock from being added to the herds, or the concea m of cases of the disease which may have occurred during the] ou u quarantine. In some instances animals were brought and] ed in the quarantined herds without the knowledge of the State veter n, and it is very evident that cows which contracted the disease easily have been destroyed and replaced with fresh animals in orue r o convince the inspector that no cases of disease had occurred, and in that way prevent the extension of the period of isolation. This fact is also to be taken into consideration in estimating the beneficial effects of the inoculation of these herds.

NEW JERSEY.

The inspections in this State have been kept up during the g part of the year, and a large number of herds have been insp of co-operation with the State board of health, which has charge o eases of animals in this State, infected herds have been q and much has been done to reduce the prevalence of the

PENNSYLVANIA.

In order to learn to what extent pleuro-pneumonia is d this State, two inspectors were sent there at different t u year with instructions to investigate and learn if the di e e any herds that were not in charge of the State authorities. of these inspectors were able to find any cases except th 1 had already come to the knowledge of the State ve na . Rose, who made the last inspection in October, 1885, r l the contagion still existed on the farms near West C r, County, which I visited in 1884. Some of these herds had b lated by the State veterinarian, but the disease continued to long after the operation was performed. The herd of Levi Lev , had been inoculated, was one of those in which the infecti tinued to exist. Three cows purchased since June have all c pleuro-pneumonia; two were sick at the time of the visit. and on made a partial recovery. Mr. Lewis stated that every n into the herd developed more or less symptoms of the di had been with the other animals a certain length of time. It reported that animals have been sold from herds in this condition. herds have not been and cannot be held safely in qua ne period that is required to destroy the contagion by the adopted.

MARYLAND.

A thorough inspection of this State has not been m e. inspectors of this Bureau is now engaged in this w in the Baltimore, but has only lately commenced, and conse ly ew returns up to this time. The following table gives a con

nent of the number of herds and animals examined during the year, nd the number found affected with pleuro-pneumonia. The details of hese inspections will be found in the forthcoming second annual report f the Bureau of Animal Industry.

SUMMARY OF INSPECTIONS.

Location.	Number of herds and stables examined.	Number of cattle examined.	Number of animals affected with contagious pleuro-pneumonia.	Number of herds infected.
New York City	870	6,947	95	45
Slaughter-houses, &c	986	4,703	295	.....
Piers steamers, &c	203	2,806	.....	.....
New Jersey	3,890	43,967	210	58
Reinspections	52	755	73	16
Abattoirs, stock yards, &c	46	.....	4	.....
Delaware	24	640	75	11
Maryland	19	378	38	11
District of Columbia	342	2,504	100	55
Virginia and West Virginia	43	1,039	17	11
Kentucky	134	1,615	104	29
Totals	6,614	64,650	1,111	236

SUMMARY IN REGARD TO PLEURO-PNEUMONIA.

] danger from pleuro-pneumonia west of the Alleghany Mountains been greatly reduced since the First Annual Report of this Bureau presented. Ohio, Illinois, and Missouri are now free from this plague. ch progress has been made in freeing Kentucky from it, and it is ved that, providing the present quarantine measures can be kept or a few months longer, the disease will soon disappear in this State. e shipment of calves and thorough-bred animals from sections of the t liable to be infected has its periods of increase and decline, as with branches of traffic; as a whole, however, it has been increasing ll continue to increase from year to year. It is now an important . of the trade of the country, and has reached such proportions that ither prohibited nor materially modified by the local quar- lations of the several States; and for the same reason it is ossible to keep such a supervision of it as will protect the West from introduction of disease. So long as pleuro-pneumonia is allowed to ex in the East it may be accepted as a self-evident propositoin that the West will be subject to invasions of it, and that no local regulations, can protect against them.

As to the prevalence of this plague in the East, the details of inspec- s show that it exists where it has been reported to exist for years. infected territory has not been noticeably increased or diminished. ins ctions were undertaken to furnish data which would serve e the measures and the expenditure that would be required for urpa n of the contagion. They cannot be taken as showing ac- t number of cattle which have been affected with pleuro- during the year, but simply as the number of cases of disease inspectors saw by going once or twice over the territory.

There were too many infected herds for us to undertake to keep them all under supervision. In many infected stables inoculation was practiced, and it was admitted by the owners that new animals brought into these herds would contract the malady unless they were protected by inoculation; often they would contract it in spite of this operation. Conversely, it may be accepted as beyond controversy that animals taken from these inoculated herds and allowed to mingle with healthy ones would disseminate the contagion. These herds, which are infected but which do not contain sick animals, therefore, do not appear on our inspection list; and it is doubtful if their shipment from State to State could be prevented under the present law, which provides a penalty for shipping *affected* animals. Two breeding herds of Holstein-Friesian cattle have been affected during the year, and other breeding herds have been exposed.

The number of infected herds in the Eastern States is so great that no attempt has been made by the Bureau to notify their owners and neighboring transportation companies of their existence. Indeed, it would have been impossible to verify the diagnosis and issue the notifications with the present limited force of the Bureau. If issued, such notifications would be of no value unless the herds were kept under supervision; this again was impossible, because of our limited force. As a matter of fact it has been difficult to prevent shipment of affected animals in the isolated outbreaks of the West where the community favored stamping out the disease and were anxious to assist and furnish information. In the cities of the East the situation is very different; the community is frequently hostile to interference; no reliable information can be obtained from neighbors; there are numerous transportation companies by which shipments may be made, and the owners of cattle will not always allow inspection. It is useless to attempt to accomplish anything under such circumstances without power to make inspections whether the owner is willing or not—and he generally is not willing if his cattle are affected—and authority to enforce such measures as are necessary to stamp out the disease as soon as found. To undertake a quarantine of infected herds without adopting measures to extirpate the contagion, would result in the accumulation of so many infected herds in quarantine that no effectual supervision could be kept up without a large number of inspectors, and an expense much greater than would be necessary to stamp out the disease at once by the slaughter of every infected animal.

Co-operation with State authorities to accomplish the prompt extirpation of the disease has not been practicable, because very few States have laws authorizing co-operation in any form for this purpose; and none have sufficient appropriations to justify their officers in attempting the slaughter of all infected herds. Our efforts in the East have, therefore, been limited to an inspection that would give an approximate idea of the infected territory, the number of infected herds, and the number of affected animals existing at any one time.

In making the appropriation for the Bureau of Animal Industry for the fiscal year ending June 30, 1886, a clause was added reading as follows: "And the Commissioner of Agriculture is hereby authorized to use any part of this sum he may deem necessary or expedient, and in such manner as he may think best, to prevent the spread of pleuro-pneumonia, not to conflict with existing law." There was a radical difference of opinion as to whether this clause conferred any additional authority for the expenditure of money over that contained in the law

May 29, 1884. Accordingly the following letter of inquiry was addressed to the First Comptroller of the Treasury Department:

DEPARTMENT OF AGRICULTURE,
BUREAU OF ANIMAL INDUSTRY,
Washington, D. C., June 18, 1885.

IR: I would respectfully ask you for a decision as to the power conferred upon the nmissioner of Agriculture by the following section of an act making appropriations the Agricultural Department for the fiscal year ending June 30, 1886:

For carrying out the provisions of the act of May 29, 1884, establishing the Bureau Animal Industry, $100,000; and the Commissioner of Agriculture is hereby authorl to use any part of this sum he may deem necessary or expedient, and in such as he may think best, to prevent the spread of pleuro-pneumonia, not to con- with existing law."

oes this language give any authority to the Commissioner of Agriculture in the of this money beyond what is conferred upon him in the act of May, 1884? It ms to have been the intention of Congress to allow this Department to compensate owners of such cattle as it would be necessary to destroy in order to stamp out the gerous outbreaks of contagious pleuro-pneumonia in the Western States; otherse there would appear no reason for inserting the last half of the sentence.

n this connection I desire to call your attention to the following extract from a er received from the Hon. Thomas Sturgis, secretary of the Wyoming Stock Growciation, dated Cheyenne, Wyo., April 24, 1885, in which he says:

l. directed by the executive committee of this association to convey to you an n of their deep interest in the question of contagious cattle diseases, and sympathy with the efforts you are making for the extinction of pleuro-pneumonia. writer and Judge Carey were members of the committee which framed and assisted ecuring the passage of the animal industry bill, and were also of the committee, past winter, which secured the passage of the clause in the legislative appropria- bill which secured the further appropriation of $100,000 and the extension of the vers of the Commissioner, permitting him to use it at his discretion. Noticing that e questions have arisen as to the power of the Commissioner to use any part of this ropriation to pay for cattle destroyed on account of disease or to prevent the spread lisease, it was thought by this committee that you might be glad to know the intion of the two Committees of Agriculture in the House and Senate at the time of passage of this last clause, and that it was understood by Congress to give the nissioner the power to pay for the above classes of cattle if he saw fit, and the on that it was put in this form was because at that period of the session the laws both Houses prohibit the putting of any addition to any appropriation bill which ot absolutely germane to the appropriation. The two houses wished to give this ver to the Commissioner, and it was with that intention that the clause referred was passed.

'For corroboration of this I take pleasure in referring you to General Dibrell, of nessee, and Hon. James Wilson, of Iowa, who were both members of the House mittee."

n early reply to the above is respectfully requested.

I have the honor to be your obedient servant,

F. C. NESBIT,
Acting Commissioner.

Hon. M. J. DURHAM,
First Comptroller, Treasury Department.

Below will be found the Comptroller's reply:

TREASURY DEPARTMENT,
FIRST COMPTROLLER'S OFFICE,
Washington, D. C., June 19, 1885.

SIR: In reply to your letter of yesterday asking my construction of the two statutes erred to therein, that of May, 1884, and that of March 3, 1885, and especially those rts of the act in regard to your powers to use the money appropriated to prevent e spread of pleuro-pneumonia, I would state that I have examined both acts, and I lieve that your power is as complete under the one as the other, and that the act of h 3, 1885, gives you no authority or additional control over the fund appropriated than that conferred by the act of May, 1884.

Very respectfully,

M. J. DURHAM,
Comptroller.

Hon. NORMAN J. COLMAN,
Commissioner of Agriculture.

This correspondence is sufficient to show, without further
tion, why no part of the appropriation has been used for the pur
and slaughter of infected herds.

INOCULATION BY STATE AUTHORITIES AND OTHERS.

Inoculation has been practiced to a considerable extent in
N. Y., by local practitioners, cattle dealers, and the owners of in
herds. In New York, New Jersey, Pennsylvania, Delaware, and
land, it has been largely practiced by the local authorities. Wh
proceeding may have saved the owners of infected herds the l
few animals, and has possibly relieved these States from a certain am
of embarrassment as to the disposition of infected herds, it must
theless, be looked upon with alarm from a national point of view.
inoculated herds are not subjected to that close supervision w
necessary to prevent the sale of animals, nor is the period of qua
maintained for a sufficient time for all danger to be passed. An
which are mildly affected are inoculated with the healthy on
within three months after the last case of the disease is known to
authorities all quarantine restrictions are removed. It is a
certain from the experience in Europe and this country with
tion, that the infection is maintained in inoculated herds for a
longer time than three months, and that fresh animals introdu
these herds are very liable to contract the disease. This point
elaborated in the Second Annual Report of the Bureau of Ani
dustry, and is referred to here to draw attention to this source of
ger which has been rapidly increasing in importance during
year.

INVESTIGATIONS IN SWINE PLAGUE.

During the past year the investigations concerning this dise
carried on without intermission. The methods adopted were th
by the most advanced investigators, as well as those which sugg
themselves to us directly, and grew out of the necessities of the
At least twenty animals were carefully examined in the earlier
the year. In nearly all instances the disease had been commu
from the sick to the healthy by contagion, either at the exper
station of the Bureau or in neighboring herds. Very few showed
disease of the lungs; in fact the disease manifested itself chiefly by
tensive ulcerations of the cæcum and colon (Plate I). The anim
gered usually from one to three weeks after the first appearance of
disease, and in nearly every case were killed in the last stages to pre
any *post mortem* changes, as the animals, when left to themselv
die early in the night and decomposition sets in very rapidly du
the spring and summer months in this climate.

It was our intention to study carefully the microbes found in the vari-
ous exudates of the serous cavities, especially that of the peritoneal
cavity, which has been considered very virulent by former observers.
In cases of advanced disease, characterized by extensive ulcerations of
the large intestine, it was found, on microscopic examination of lymphatic
glands and other organs invested by the peritoneum, that the latter
membrane was covered with a layer of lymph, in which were imbedded
various kinds of bacteria, micrococci of different sizes, slender as well
as thick bacilli. Cover-glasses brought in contact with the peritoneum

wise contained several forms. Finally, the persistent impurity of contents of vacuum tubes, as well as cultures made directly from serous effusions at the *post mortem* examination, forced us to conclude that we must not look for any pure cultures from this source. he inference was that microbes gained access to the closed cavity rough lesions caused by the extensive ulcerations of the large intestine which always accompanied these cases, and that they were not ere destroyed either because the system had been so debilitated or e microbes were capable of a parasitic existence.

The peritoneal exudate had been pronounced virulent by Klein, who nce obtained the bacillus claimed by him to be the cause of swine plague. e determined to isolate and study the different bacteria which we uld meet with in this exudate by culture and inoculation. If the in the intestine were due to a local multiplication of the specific icrobe in the mucous membrane, it seemed natural to suppose that would be very abundant in the contents of the intestinal canal and ould find its way with the other bacteria into the peritoneal cavity, id that, having become adapted to the struggle with animal tissues, it ight even outgrow the other forms in this situation. At the same the possibility must not be set aside that septic bacteria might n entrance in the same way by a rapid invasion of the blood or lymc channels or both, materially change the clinical aspects of the e, and give rise to various apparently inexplicable phenomena ıu quelæ. In two cases a bacillus was found in the peritoneal cavity ade up of long, jointed filaments, and probably identical with the bacillus of malignant œdema (*Vibrion septique*), the spores of which, according to Koch, are abundant in the soil. These filaments were found great abundance upon cover-glasses upon which a delicate film of eritoneal exudate had been dried. In another pig, which died in the ght during a heavy frost (November 22, 1884), and which was examl early next morning, a cover-glass touched to the peritoneal surface the liver was found crowded with a bacillus in long, jointed filaments, doubt identical with the preceding. The appearance of the abdomal cavity in this case, as indicated in the notes of the *post mortem*, e briefly as follows:

Abdomen on opening emits a faint odor not observed in previous es. Ulcers of the mucous membrane of the large intestine plainly le through the peritoneum; peritoneum dry, no serum in the cav, no evidence of peritonitis. Liver of a pale reddish color; on secon bloodless; cæcum and colon studded with ulcers, some covered ith a projecting black necrotic mass. Sections of the liver hardened alcohol were found to contain three different forms of microbes, the icillus found on the surface of the liver, the individual filaments of hich were very long, a small slender bacillus, and a micrococcus; these ere present in equal numbers. The cover-glass with which the perineal surface of the large intestine had been touched in close proximity the ulcers revealed not a single microbe among the numerous epithells which had come away. Thus the invasion of the bacillus was doubt by way of the bile ducts in this case. The presence of such numbers of microbes in the liver tissue can hardly be accounted by *post mortem* growth in this instance. In blood collected from and examined unstained, this same bacillus was found, the le and almost disintegrated.

io made of one of the ulcers, the mucous membrane was found thrown off, as well as a portion of the submucous connective The muscular layer was replaced by an inflammatory infiltra-

tion of cells and enormously thickened, so that the line of fat in the submucosa was pushed forward into the lumen of the t formed two sides of a cone (the apex of which had sloughed a tween the mass of infiltrated cells. Various kinds of bacte found in this inflammatory tissue, but towards and beneath toneum were colonies of micrococci occupying intervals between and layer spaces probably lymphatic. This case is cited simply out what may be found in a case of advanced swine plague in w lesions are concentrated in the large intestine chiefly, and t mostly intact. It indicates somewhat the difficulties in the time that must be consumed before any trustworthy results tained, and the caution that must necessarily be exercised in c a conclusion.

In endeavoring to carry out the plan of isolating and cultiva bacteria found in swine plague, the work was retarded by the of keeping on hand cases of swine plague contracted in the natu and by the heat of summer which completely interfered with nary nutritive gelatine cultures. Finally a special "cold box" structed in connection with the cold-air chamber of an ordinary rator, and thickly padded with felt. The air within this box, munication with that of the refrigerator by an upper and low remained about 10° F. below the temperature of the laborator for several months rarely fell below 90° F. at night. Plate-cult tube-cultures were kept in this box, and only removed for pur examination and inoculation. In this way only were we able gelatine after losing many plates upon which hours had been day previous.

Perplexed by contradictory results and failing to obtain any nic germ by isolating the different forms found in the peritoneal the discovery of a fine bacillus in Germany causing a disease which was regarded as identical with swine plague in England United States aroused our attention. The bacillus, of exceedi size, was described as being present in large numbers in the sp other organs of diseased pigs, and that the disease could be at on mined by examining portions of the spleen, dried on cover-gl this bacillus had never been seen by us we decided to examine t very carefully in order to determine its presence or absence.

The disease having for the moment died out at the experime tion, our attention was directed to an outbreak in Salem Cou Jersey, where it had assumed quite extensive proportions. Tw animals were killed. In both, the large intestine was extensiv ated, the lungs partially hepatized, and the large serous cavit with effusion. Without going into details, we need but to stat numerous cover-glass preparations of the spleen the fine baci absent; cover-glass preparations of lung tissue and of the ser sions equally negative.

In regard to the cultures made in gelatine tubes, the results differ from those obtained heretofore. In three cultures of the one animal nothing grew; in one from the other animal, three colonies appeared. Several cultures from the same animal were negative. From the spleen of the first, three different micro isolated—two micrococcii and a bacterium. In cultures from bl serous exudates, several other forms were isolated. In all, five from these two animals were studied (4 micrococci and 1 bacteri oculations of each into two mice and two pigs failed to produ ease with the exceptions mentioned below. The cultures in

proved that both in the blood and in the spleen these bacteria were very few in number, so that they could not be detected in cover-glass preparations. We were fully satisfied that the fine bacillus claimed to be the cause of the disease in France and Germany was not present.

Anticipating somewhat the conclusions which we arrived at later concerning the real cause of this puzzling disease, we must say, at this point, that we no longer consider a micrococcus as the cause of all outbreaks of the disease known as swine plague. The First Annual Report of the Bureau mentions the death of three pigs from inoculation with a micrococcus. This micrococcus is easily distinguished by its peculiar growth on gelatine, which it rapidly liquefies. Since that time it was not found excepting in one of the two cases just described. The inoculations with this produced a rise of temperature within ten days in the two animals which subsided a few days after. One of the animals was killed about seventeen days after inoculation. The lungs were found extensively hepatized. The presence of numerous lung worms left us in doubt as to the cause of this hepatization. Tubes inoculated from the spleen and blood remained sterile. The second animal died of swine plague one month after inoculation. The results which we obtained later on with another microbe lead us to suspect that this was a case produced by natural infection. Whether this micrococcus is a septic organism or one which is the cause of a definite disease in pigs cannot be answered at present.

The attention aroused abroad by Pasteur's vaccine as a protective against the disease known as *rouget* in France and *Rothlauf* in Germany, there regarded as identical with the disease prevailing in our own country, led us to examine carefully two tubes of vaccine known, respectively, as first and second vaccine, which were kindly sent to us by Prof. A. Liautard, of New York, and which he had received directly from Pasteur's laboratory. We were surprised to find that the microbe in the vaccine was identical with that described by German investigators as being the cause of the disease in Germany. This microbe was without doubt a bacillus, exceedingly small, to be sure, but not at all recalling the microbe originally described by Pasteur and Thuillier as having the form of a figure of eight. We shall later state our reasons for supposing that the microbe first discovered by Thuillier, and the one now cultivated as a vaccine in Pasteur's laboratory are two entirely different microbes and the cause of two distinct diseases. In the following chapter the results of our experiments with the vaccine are given in detail, and from them it will be seen that it does not prevent swine plague, for the simple reason that the vaccine of one disease cannot protect against another.

AN EXAMINATION OF PASTEUR'S VACCINE FOR ROUGET.

On October 16 a tube was received at the laboratory containing about 15^{cc} of Pasteur's vaccine for rouget, the European swine plague. The color of the liquid, which was faintly turbid, was of a light reddish yellow. A rubber cork securely closed the mouth of the tube. On drying minute portions on cover glasses for the purpose of examining the kind of microbe it contained, the culture liquid was found to contain a considerable proportion of solid matter which formed a thick layer on the cover-glass and did not adhere firmly during the operation of staining with aniline. This residue is in all probability peptone, as there is no precipitation on boiling. Judging from the amount of residue the culture liquid contained at least 2 per cent.

When stained in methyl-violet, prepared by adding a drop of an alcoholic solution to a watch glass of distilled water, and examined with a $\frac{1}{18}$ homogeneous objective, the microbes appeared as bacilli in the form of very slender filaments which assumed various curves, loops, and broken lines. As the manner in which the vaccine had been put up did not seem to guarantee the absolute purity of the culture, a number of plate-cultures were made whence to obtain pure cultures. Two days later a few scattered colonies appeared in the form of a rosette of club-shaped elements; these were small bacteria. On the following day a large number of very small round colonies could be discerned with a magnification of about 60 diameters. These were no doubt the fine bacilli. A greenish film began to encroach upon the plates and liquefy the gelatine. A microbe was described by Schütz as being in the vaccine used in Baden which produced the same greenish coloration. Five days after the plates had been prepared the colonies could not yet be distinguished with the naked eye. Under a 1-inch objective they appeared as large as pin's heads. To avoid total loss of the plates by the encroachment of the chromogenous, putrefactive microbe, a spot was selected under a dissecting microscope free from colonies of what were supposed to be contaminating bacteria; a minute portion of the gelatine layer containing a number of barely visible colonies was dug up and transferred to 10^{cc} of beef broth with 1 per cent. peptone. On the 23d, two days after inoculation, a faint opalescence was observed in both tubes, which, on shaking, was resolved for the moment into delicate rolling clouds. There was no membrane or deposit. From another plate, a tube culture in nutritive gelatine and one in beef broth with peptone were made in the same way. In three days the liquid culture presented the same appearance as those made from the other plate. Films, dried on cover-glasses, and stained for half a minute, contained the same bacilli as those found originally in Pasteur's liquid vaccine. The track of the platinum wire in the tube of gelatine became opaque in a few days. A row of cloud-like masses began to spread from it as a center and appeared as if strung on the needle track which was now very faintly discernable. (Plate II, Fig. 6.) These clouds were fringed at the edges, and when approaching one another the entire growth presented the appearance of a minute test-tube brush* forced down into the transparent gelatine. We were, therefore, led to conclude from microscopical and culture appearances that the microbe of Pasteur's vaccine was not a figure-of-eight form as he himself described, but a bacillus not to be mistaken for a micrococcus.

(*a*) *Inoculation with the first vaccine, in mice.*—It had been experimentally determined by Löeffler that the bacillus of rouget resembles very closely the bacillus which produces septicæmia in mice, in microscopic appearances, in its mode of growth in gelatine as well as in its behavior towards the white blood corpuscles in the body of the infected animal. If the bacillus of Pasteur's vaccine is identical with the bacillus of rouget in Germany, and not too attenuated, it should produce septicæmia in mice. On October 17, three mice were inoculated by injecting beneath the skin of the back of two 5 drops, of the third 10 drops of the vaccine; they were kept in a large glass bell-jar covered with a sheet of tin perforated with large holes over its entire surface, and supplied abundantly with food and water. To avoid pain they were invariably chloroformed before inoculation. October 20, one mouse was plainly ill; it moved with difficulty, had a staring coat and suffused, partly closed,

* Within a few days a book on rouget (Lydtin u. Schottelius *Der Rothlauf d. Schweine*) was received in which the term "test-tube brush" is also used in describing the appearance of the gelatine culture.

ɔs. It was found dead the next morning, or about four days after in-
ılation. Portions of the spleen, liver, and blood from the heart were
ɔbed on cover-glasses, dried and stained for half a minute in an aque-
ɜ solution of methyl-violet. Two cultures, one in gelatine and one in
ɛf-broth peptone, had been previously made. On the three cover-
.sses very fine bacilli were found quite abundantly, some free and
ne within white blood corpuscles (Plate II, Fig. 5). In one cell, at
st thirty could be counted. The presence of large numbers of bacilli
white blood corpuscles from the spleen of mice in which septicæmia
l been produced by the injection of putrid blood was pointed out as
back as 1878 by Koch, and lately confirmed by Löffler and Schütz,
mice inoculated with the virus of rouget. The culture in gelatine of
ɔod from the heart assumed precisely the same appearance as did the
.ture from the gelatine plates. The liquid culture proved to be made
entirely of the fine bacilli, while its microscopic appearance coin-
.ed with the liquid cultures from the gelatine plates. October 24, an-
ıer mouse showed symptoms of illness. The eyes were slightly suf-
:d, the coat staring, and the respiration labored. It lived through
ɔ next day, but was found dead on the morning of the 26th, nine days
er inoculation. In the liver and blood a moderate number of bacilli
re found; in cover-glasses of the spleen they were not observed. A
.ture of blood from the heart in beef-broth peptone contained, two days
er, a pure culture of the slender bacilli. The third mouse remained
ll. Inoculations with the pure cultures of the vaccine were not at-
ɑpted for want of time. The above illustrates very clearly how in
'tain cases pure cultures may be obtained from impure mixtures by
ıply inoculating with the mixture an animal susceptible to one of the
ms only.

The foregoing experiments seemed to us sufficient proof that the mice
d died from a multiplication in the various organs of the bacillus
ınd in Pasteur's vaccine. We were also convinced that the bacillus
ltivated as a vaccine in France was identical with the bacillus re-
rded as the cause of rouget in Germany.

(*b*) *Vaccination of pigs.*—October 16, pigs 78 and 94 were inoculated,
ɛh with five drops of the first vaccine, one-half into each thigh; Nos.
and 95 received in the same manner about 2^{cc} each of the same vac-
ɔ. Pig 78 died October 20. Having a black skin discolorations
ıld not be made out. In the peritoneal cavity a very large quantity
coagulable, straw-colored lymph was found; a fibrinous exudate cov-
ɛd the coils of the large intestine and lumps of the same lay loose in
ɐ cavity; the peritoneum itself was pale. The liver was of a pale
sh color and almost bloodless, the lobules standing out very distinct.
fibrinous exudate matted the different lobes together. Lungs of a
sy color, slightly congested, some serum in the pleural sacs as well as
the pericardial cavity. Right heart distended by a clot, left empty.
the stomach an intensely red patch was found near the pylorus cov-
ɪ with a whitish mucous layer, readily removed. The intestines ap-
ently healthy. The inguinal glands of one side were considerably
ɛned. In order to see how far the inoculation with a few drops of
vaccine was accountable for death, cover-glasses upon which bits of
spleen and liver had been rubbed and others upon which blood and
ım from the peritoneal cavity had been dried were examined, but
contained no bacteria of any kind. Cultures in gelatine tubes
prepared with a platinum loop from the peritoneal, pericardial,
pleural effusions from the cut surface of spleen and blood from the
. A portion of the spleen was dropped into a liquid culture at

the same time. A pipette was filled with the peritoneal effusion and one with blood. On the following day two tubes, one of meat broth, the other of meat broth with peptone, received each several drops of the peritoneal exudate from a pipette. Two additional tubes were inoculated with a platinum loop from the pipette containing blood from the heart.

All of the above cultures remained sterile excepting the two liquid cultures of the blood and the gelatine tube containing a portion of the spleen. Both the former became faintly clouded on the second day after inoculation, and were found pure cultures of the bacillus found in the vaccine. It is probable that they had multiplied in the pipette over night and made infection possible, as their number in the blood must have been very small.

In about two weeks after inoculation a faint, cloudlike growth from the bit of spleen, which was about the size of a split pea, downward into the gelatine could be easily seen. When the bit of spleen was removed a week later and rubbed on cover-glasses, exquisite preparations of the rouget bacillus were obtained. Masses of filaments could be seen interlacing with one another in all directions. Most of the filaments were of considerable length (20 to 30 micro millimeters). The injected bacilli had thus penetrated the system quite thoroughly, though present at any place in but small numbers.

The three remaining pigs which had been vaccinated appeared undisturbed by the operation. The temperature chart is given on page 484 in connection with the second vaccination.

A tube of the second vaccine was received at the laboratory on October 23. It remained unopened in a cool box at a temperature of 60° to 65° F., until October 28, when a portion was used for the second vaccination of pigs, another for the inoculation of mice, and a third for microscopical examination and cultivation. In general appearance, color, and consistency the liquid resembled the first vaccine closely. On removing the rubber stopper there was a sudden outrush of air, which scattered a portion of the liquid as a fine spray. At the same time minute air-bubbles rose to the surface of the liquid forming a delicate, white foamy layer.

Portions were immediately dried on covers and stained in an aqueous solution of methyl-violet. Examined with a Zeiss $\frac{1}{12}$ homog. Oc. 2, two kinds of bacilli were found. (Plate II, Fig. 4.) Large ones with rounded extremities from 2.5 to 4 micromillimeters long and about .7 micromillimeters broad, a few in chains of two to four, the majority isolated. Some failed to stain deeply, probably because dead. The other bacilli resembled closely those found in the first vaccine. They occurred in slender filaments, either curved or angled. Some of the filaments were plainly jointed, the segments measuring not more than from 1 to 1.2 micromillimeters in length; a few isolated bacilli were of the same length as the segments of the longer filaments.

Plate cultures were at the same time prepared by adding two drops of the vaccine liquid to 10^{cc} of beef broth peptone and mixing one drop of this dilution with 10^{cc} of nutritive gelatine, which was spread on two plates. At the same time two additional plates were prepared by adding merely a platinum loop of the dilution to 10^{cc} of the gelatine. Though examined from time to time for nearly a week no colonies of the bacillus could be detected. But this was easily explained when the tube, which formed the dilution for the plate cultures, was found sterile after four or five days. It seemed as if the microbes were dead; the large as well as the small bacillus. On October 31 two additional cult-

es were prepared by adding to each about four drops of the vaccine, hich, after exposure, had been kept in a refrigerator. On the third y one culture was faintly clouded and found to contain the delicate icilli: the other tube remained clear. The great majority of the bacilli the vaccine were evidently incapable of multiplying. That the cult-e liquid was not at fault was afterwards proved by inoculating the ibes which had remained sterile with pure cultures of the first vaccine. n abundant growth was observed in two days.

(*a*) *Inoculation of mice.*—On October 28 two mice were inoculated, each ith one drop of the second vaccine, three with three drops each, and e with four drops. The mouse inoculated with the first vaccine and ill well received about two drops. October 31 one of the mice inocu-ted with three drops was found dead. Limbs partly flexed, eyes half osed. The organs were normal in appearance, excepting the lungs, hich were intensely congested. Cover-glass preparations from the ver, spleen, blood from the heart and lungs contained no bacteria; a eat broth peptone and a gelatine culture inoculated with blood from the eart remained sterile. In this case death could not have been caused y the inoculation. On November 4, one week after inoculation with ree drops of the vaccine, a second mouse died, after having shown signs f illness for a day or two previous. It was found with limbs flexed, as in tting, but it had fallen forwards on its head from a piece of bread on hich it had been sitting. The back was arched, the eyes closed with ight secretion. On removing the skin of the abdomen a few red patches ere found on its under surface. There was a collection of serum in the ld of the groin on each side where the lymphatic glands stood out rominent. There was some serum in the peritoneal cavity; the spleen as dark and tumefied, the liver quite dark, kidneys pale. On section ie cortex was paler than the medulla; through both regions small rami-cations of a dark red color extended; lungs normal. Cover-glass prep-rations revealed the minute bacilli in the blood from the heart, in the ngs, spleen, liver, and kidneys. Their number in all organs, except-g in blood from the heart, was enormous. In the lungs, liver, and leen large pale cells were found in large numbers gorged with the illi. (Plate II, Fig. 5.) Small cells were also observed in which the ained bacilli were so numerous as to give the cell a deeply stained, ticulated appearance. A gelatine and a liquid culture were prepared y snipping away the apex of the heart with flamed scissors and trans-rring some blood with a platinum wire. These tubes, strange enough, mained sterile. The remaining mice showed no signs of disease. hese experiments go far to demonstrate the identity of the pathogenic acilli in both vaccines. The large bacillus may have been some harm-ss microbe, the introduction of which into the culture took place no oubt when the tubes were originally filled with the vaccine liquid.

We infer from the culture and inoculation experiments that the second accine was as weak as the first, probably much weaker. The bacilli f the first vaccine developed abundantly on gelatine plates, while those f the second did not. The latter failed in two out of three cases to row in liquid media, while the former readily grew in all inoculated ibes. Their behavior towards the mice agrees with these determina-ns. The efficiency of the vaccination, which depends on the quality the second as well as that of the first vaccine, is much impaired when strength and vitality of the preparations cannot be relied on. It is that there is much time lost in importing the vaccine from Paris as both vaccines were subjected to the same conditions, the great nation of the second vaccine in comparison with the first must be

ascribed to a failure in preparation. In fact, it is reasonable to anticipate that the time lost in importing the vaccine would be a serious obstacle to its application in this country, even if it could be shown, which is by no means proved, that the same disease existed here, as long as the present methods of keeping the vaccine remain in use.

(*b*) *Vaccination of pigs.*—The vaccination was undertaken October 28, twelve days after the first vaccination. Pigs Nos. 76, 94, and 95, which had received the first vaccine, were inoculated by a hypodermic injection of about two and a half drops, which is the prescribed dose. In addition to these, two other pigs, Nos. 103 and 104, received each about 2cc of the same vaccine, one half into each thigh. Our object was to produce the disease, if possible, by a large dose, and compare it with the disease prevalent here. None of the animals became sick, however. The following table gives the temperature of each vaccinated pig from the day of the first vaccination to November 5:

FIRST VACCINATION, OCTOBER 16.

Date.	No. 76.	No. 78.	No. 94.	No. 95.	No. 103.	No. 104.
	°F.	°F.	°F.	°F.	°F.	°F.
October 16	103	102½	104⅛	103	.....	.....
October 17	103½	102	104⅛	102⅜	.....	.....
October 19	102½	102½	103½	103⅛	.....	.....
October 20	103⅜	Died.	104	103½	.....	.....
October 21	103⅛	.....	103⅜	103½	.....	.....
October 22	103⅜	.....	103½	102⅛	.....	.....
October 23	104⅛	.....	103	103	.....	.....
October 25	102	.....	102½	103	.....	.....
October 26	102⅜	.....	103½	103⅛	.....	.....
October 27	102½	.....	104	103	.....	.....
October 28	103	.....	103⅜	103⅜	104⅛	104⅛

SECOND VACCINATION, OCTOBER 28.

October 29	103	.....	103	102⅜	103½	103⅜
October 31	103½	.....	103⅞	103	103⅜	103⅛
November 2	103	.....	103	103½	103⅜	103⅛
November 5	102	.....	102½	103	102⅜	103⅛
November 6	102⅜	.....	103⅞	103⅜	103⅜	101

One week after the second vaccination these pigs were penned with two others which were affected with swine plague of a very severe type. These animals had been obtained from a place several miles from the experimental station on November 4, as no cases of swine plague had been kept at the station since the summer of the same year. One of these pigs, No. 105, died on the same day, the other, No. 106, died in the night between the 6th and 7th. The contact of the healthy with the diseased did not extend over a period of more than two days therefore.

The history of these vaccinated animals is briefly as follows: On the morning of November 15, pigs Nos. 95 and 103 were found dead. The former had been twice vaccinated, receiving about 2cc of the first vaccine (at least ten times the proper dose) and about three drops of the second. Pig No. 103 had received about 2cc of the second vaccine only also about ten times the prescribed dose). *Post mortem* at 2 p. m., temperature of the night previous and day 40° to 50° F. There was no distinct discoloration of the skin noticeable. The superficial lymphatic glands of the groin were tumefied and reddened. On opening the abdomen the small intestines were found studded with whitish excrescences, caused by the attachment of echinorhynchi. Delicate filaments stretched across the coils of intestine and some serous effusion indi-

ated slight peritonitis. Mesenteric glands enlarged and congested, nesenteric vessels dark, gorged with blood; lungs and heart evidently ntact; the bronchi contained a few lung worms; spleen and liver not ioticeably changed. In examining the intestinal tract a large area of he mucous membrane of the stomach was intensely reddened, some places of a bright scarlet, others duller. The ileum was congested; no ulcerations visible. The cæcum and large intestine were intensely reddened. For some distance from the valve the mucous surface was studded with small discolorations which on close examination were seen to be depressions of commencing ulcerations. About the ileo-cæcal valve here were small masses of yellowish matter plugging the distended nouths of the flask-shaped glands. In pig 103 the *post mortem* appearances were as follows: The major part of the lungs was highly congested, considerable quantity of a pale reddish liquid in both pleural sacs. ne surface had a mottled appearance due to islands of dark red color surrounded by paler tissue; no hepatization; lung-worms present; stomach and small intestine not affected; echinorhynchi attached to its walls; ascarides extending up into bile-ducts. Large intestine and cæcum intensely congested as with No. 95; a large patch of ulcerations about the valve; a few nodular swellings, probably enlarged follicles. The lymphatic glands of the abdominal cavity in general tumefied, purplish. We felt no hesitation whatever in pronouncing both as having had swine plague.

Pig 104, which had been inoculated with the second vaccine only, but which had received a large dose of the same (about 2^{cc}) was found dead November 7, and examined immediately. There was no discoloration of the skin perceptible. The superficial lymphatic glands of the groin somewhat enlarged and slightly reddened. A small quantity of serum in the abdominal cavity. Dark bluish protuberances and whitish spots on the small intestine indicated the presence of echinorhynchi. The lungs were much congested; the bronchi filled with lung worms; some ascarides in the stomach. Lesions characteristic of swine plague were not found in the large intestine.

Pig 94, which had received five drops of the first and about three drops of the second vaccine, died very suddenly on the morning of November 18. It had been apparently well a few hours before death. The *post mortem* examination was made within an hour after death. The skin of the ears, about the vulva, and along the middle line of the abdomen covered with a red blush. Isolated red patches on the inner aspect of the limbs and on the vertical aspect of the neck. The inguinal glands beneath the skin enlarged, pale; on incision much serum flowed. The subcutaneous fatty tissue over the lateral aspect of the abdomen was dotted with numerous punctiform extravasations. In the abdominal cavity the large intestine presented a very striking appearance. Beneath the peritoneal coat, throughout its whole extent, it was covered with innumerable blood extravasations, varying from a mere dot to oblong patches about one-eighth to one-quarter of an inch long. The spleen, somewhat enlarged, was dotted with numerous, slightly-elevated, dark ots. The stomach, along the lesser curvature, was sprinkled with ecuymoses. The peritoneal cavity contained a moderate quantity of um. The right heart was filled with serum, darkened by suspended corpuscles; the left quite empty. On the auricles a number of minute dots were present. The lungs were but slightly congested. Over surface of both were scattered numerous dark red patches about one-ith of an inch in diameter. On section these were found to corre nd to dark hepatized lobules beneath. A few lung worms present.

All the lymphatic glands in the thoracic cavity were of a very dark-red color. On section this color was found throughout the gland and a large amount of dark-colored blood flowed from the cut surface.

The lymphatic glands about the stomach and along the entire extent of the meso-colon were enlarged, dark purplish, similar in appearance to those of the thorax. Those of the colon resembled dark-red beans in size and color. The glands of the mesentery were enlarged, the cortex reddened, medullary substance slightly so. The mucous membrane of the stomach was studded with red points near the lesser curvature. In a few places hemorrhages had occurred. The clots, when pulled away, revealed patches thickly covered with ecchymoses. The small intestine in general did not exhibit any signs of inflammation, as the membrane was quite pale. But here and there red points and larger patches of extravasation were found. The large intestine, distended with food, was the seat of the most extensive lesions. The entire mucosa was thickly dotted with ecchymoses varying in size from points to large purplish patches. In the rectum small red patches, when examined with a lens, were found to consist of a network of injected vessels. Among the contents of the large intestine, about 10 inches from the ileo-cæcal valve, a black mass as large as a man's fist was found, which was made up of feces enveloped in a thick layer of clotted blood. In the subperitoneal tissue near the cephalic border of each kidney there was an ecchymosis about 1 inch in diameter. In one kidney a papilla contained several small ecchymoses.

This animal was free from intestinal worms, differing in this respect from the majority of those which were examined about the same time. The animal had succumbed to the first onset of a very virulent attack of swine plague, so that ulceration had not yet begun in the large intestine.

Pig No. 76, an adult animal, is still alive (February, 1886), and to all appearances well.

Thus three of the five animals which had been vaccinated died of swine plague, and, moreover, in the early stages of the disease. One of them, pig 94, just described, had been in excellent condition and was comparatively free from parasites. Hence any protection from the American swine plague conferred by vaccination was out of the question.

Moreover, in these cases great care was bestowed on the examination of cover-glasses of the spleen, of the various exudates, and blood from the heart. In none of them could the delicate bacilli of rouget be detected. We had sufficiently familiarized ourselves with their appearance in the vaccines, in cover-glass preparations of the organs of mice inoculated therewith, and in cultures in liquid and solid media, so as to exclude any errors of observation. We are enabled to say that we could not detect them by means deemed sufficient by European investigators. We claim, from our own investigations, that the disease prevalent in the East, and probably over the entire country, is different from the disease called rouget. The above experiments with Pasteur's vaccine do not, in our opinion, therefore, disprove the protective power of Pasteur's vaccine over rouget, but simply show that the vaccine for one disease will not protect against another.

CONCLUSION OF THE INVESTIGATIONS CONCERNING THE CAUSE OF AMERICAN SWINE PLAGUE.

The two animals which infected the vaccinated pigs, as described in the preceding pages, deserve our attention more particularly, since they

ıe starting-point of an outbreak at the experimental station, ıas finally enabled us to demonstrate as the cause of the disease .lc microbe. This outbreak was characterized by great virulence, st of the infected animals died in the early stages of the disease. ɔ two animals, when brought to the station November 4, ex- the usual symptoms of swine plague, great depression, with pro- arrhea. The owner stated that they had been sick for about a On the following day one (No. 105), was so low (temperature, that we decided to kill it, the warm weather not promising good ation if it should die in the night. It was killed by a blow on .d. The skin was slightly bluish in the axilla, a similar but less l discoloration on the abdomen. The superficial inguinal glands eatly enlarged, the individual lobules standing out prominently, f a pale flesh-color, others purplish, medulla pale. In opening lomen a few whitish patches were observed on the small intes- rresponding to ulcerations, as determined later.

e was a moderate quantity of watery serum in both pleural sacs. ıgs were normal, with the exception of a small anterior lobe on ide which was hepatized. The pericardium was slightly dis- with a colorless fluid; a small clot in each ventricle. Very severe were found in the intestinal tract. The partially-empty stomach ed two coiled up specimens of *ascaris*. The pale mucosa was l with several isolated yellowish ulcers, about one-fourth of an diameter, raised above the surface and flattened at the top. In ım extensive ulcerations were found, extending for a distance of feet from the valve. These ulcers had a depressed base, as if the ıad been dug away, and were surrounded by a smooth elevated

In the cæcum and large intestine in general, the ulcerations ery numerous, varying from one-eighth to one-third of an inch in er. The smallest ones appeared as yellowish specks. The larg- s were slightly depressed, containing black, ragged, necrotic . The lymphatics, at the root of the mesentery and near the ileo- alve, were greatly enlarged, representing a continuous cylindrical t least an inch thick, and varying from a pale flesh-color to a d.

was evidently a severe case of swine plague, and one which, from ıs experience, would prove unsatisfactory for purposes of inves- ı. Three cover-glass preparations from the spleen, one from the wo each from the hepatized lung tissue, and blood from the heart, earched with negative results. No bacteria could be seen. A in a tube of nutritive gelatine rapidly liquefied the gelatine in ck of the needle. Several kinds of bacteria were present, includ- hromogenous bacillus, described as *bacillus luteus suis* in the Sec- nual Report of the Bureau. This same bacillus was also present other forms in a liquid culture inoculated directly with blood from art.

id cultures were made by inoculating sterile nutritive media with ıum wire dipped into the parenchyma of the spleen and liver, d by a cut with a flamed knife. Both contained a motile bac- identified later as the bacterium of swine plague. When line s were made on gelatine, that of spleen was obviously pure; the s from the culture of liver were of two kinds—one, the bacterium ıe plague proper, as determined later; the other growing in colo- wing only one-fifth the linear dimensions of the former. A liquid prepared by rubbing the platinum wire over the peritoneum, when tested by the above method, the swine plague bacte-

rium and another microbe growing in colonies, which differed from the former only in a want of color and opacity. Thus two of the three cultures were impure, as anticipated, but all contained the same motile microbe.

In order to test the matter more thoroughly a number of mice were inoculated November 6, as follows: After chloroforming, a portion of the skin near the root of the tail on the back was freed from hair, the skin cut with scissors, and a small portion of tissue introduced into the pocket thus formed. Three mice received in this way a small ulcer from the large intestine, two each a bit of hepatized lung tissue, spl and kidney. Those inoculated with the same kind of tissue were l in the same jar.

One of the mice (No. 3) inoculated with a bit of kidney be November 9 (on the fourth day); it had a staring coat, eyes o n. suffused; dead next morning. There was no reaction at the s on inoculation, no serous infiltration of the subcutaneous tissue; l phatics of the skin-fold of the groin dark red, also spleen; liver pale, almost bloodless; bladder greatly distended with urine. Co glasses of kidney, spleen, liver, lungs, and blood from heart cont fine bacilli, resembling very closely in disposition and size those when were found in mice inoculated with Pasteur's vaccine.

A liquid culture, prepared from the blood, was turbid on the following day. It was found to contain a large bacillus, besides the delicate bacillus, which appeared in long filaments. As the former rapidly liquefied gelatine on plates, and an isolation was found impossible without much extra labor, three mice were inoculated November 12 with about five drops each of this culture in order to obtain a pure culture in this way. One mouse (No. 8) died on the following day. All internal organs were crowded with large bacilli. This fact, taken together with the œdamatous condition of the subcutaneous tissue of abdomen, led us to infer malignant œdema as the cause of death. On November 14 a second mouse (No. 11) was found dead. There was a sero-sanguineous effusion, as in the first case, and in all the organs large bacilli were found, but in addition, the fine bacilli were present in enormous numbers, especially within the cells. In the blood long, wavy filaments of the large bacillus were found, often interlaced. The third mouse (No. 12), being very sick, was killed with chloroform. No œdema, no large bacilli, but the fine bacilli in immense numbers. From the blood of the heart two pure cultures in beef broth peptone were obtained. in which the bacilli appeared November 16 as wavy, curled, or ang filaments. The contaminating bacillus produced in the gelatine c ures a surface liquefaction and cloudiness of the gelatine, while colonies of the same bacillus below the surface in the track of needle appeared as minute, roundish specks, not liquefying the gelat

The culture in nutritive gelatine developed in a characteristic From the track of the needle faint cloud-like processes exten u ally almost to the sides of the tube, so as to impart to the entire g tine a cloudy appearance. The cultures of the bacillus of rouget different in that the growth remained near the needle track, and h was denser. This difference is also mentioned by foreign investiga (*Löffler, Arbeiten a. d. Kaiserlichen Gesundheitsamte*, Bd. I, S. 47.)

We give these results in detail, because it is the only time in our work in which the fine bacilli resembling rouget made their appearance, either n cultures or in the experimental animals; and their growth in gelatine sufficiently disproves their identity with the bacilli of rouget.

Of those inoculated with the ulcer, one died on the tenth day, the

ther (No. 2) died on the fifth day, the third (No. 4) on the seventh day fter inoculation.

In the lungs and spleen of No. 1 a moderate number of bacilli were ound, while cover-glass preparations of kidney and liver showed none. he bacilli varied in length from 2 to 10 micromillimeters, and were out .6 micromillimeter broad; ends rounded. Mouse No. 2 died of naliguant œdema. The kidney of the third one (No. 4) contained large umbers of the oval bacteria, found in cover-glass preparations of the pleen in pigs affected with swine plague later on, and identified as the ause of swine plague. The paler center was very distinct, suggesting ery strongly the appearance of spores. This was the first time these acteria were seen, since the cover-glass preparations made from the rgans of pig No. 105, whence these mice had been inoculated, proved ntirely negative. The cultures, both solid and liquid, obtained from he heart's blood of these mice proved, as might have been expected, o be mixtures of several kinds of bacteria. The gelatine invariably ecame liquid. For want of time they were set aside. Two mice, inculated with a piece of kidney of mouse No. 4, November 12, were uite sick November 14 and killed with chloroform, but no bacteria ound in the organs of either animal. The two mice inoculated with a it of spleen seemed well about a week after. They were then removed rom the jar in which they had been placed after inoculation and placed n a larger cage with other healthy mice. A few days after one was ound dead, but owing to want of time was not examined. About fifeen days after the date of inoculation the other was found dead. On xamination the site of inoculation was healed over. The spleen was ound enlarged to four or five times its normal size, its color resembling hat of striped muscle. The surface of the kidney contained a few hitish patches. Liver with a tape-worm cyst. Lungs slightly congested. In the kidney numerous oval bacteria were found, precisely imilar to those found in mouse No. 4 and in the spleen of the deceased igs. In the spleen the bacteria were of the same size, but no pale enter was noticed. Our attention was now aroused to the long period f this disease in mice accompanied by this bacterium, which was charcterized by its elongated, oval form and its pale center when stained a few minutes with an aqueous solution of methyl-violet.

The other pig (No. 106), brought to the station with No. 105, died in the night between the 6th and 7th of November. The weather was warm and favorable to decomposition. On examining the viscera in the morning the lesions were found somewhat different from those of pig No. 105. The lungs were apparently intact. In the digestive tract a patch of the mucous membrane of the stomach was deeply inflamed, presenting an intensely red color. The ileum, though severely inflamed, was free from ulcerations. In the large intestine there were three or four ulcerated patches about an inch square near the valve. The mucous membrane in the remainder of the intestine was studded with closely-set, blackish, depressed spots, evidently old extravasations, and about to become ulcers. In this animal the lesions were not so far advanced as in the previous case.

Cultures in gelatine and liquid media of the spleen and blood from heart remained sterile, with the exception of one colony in the gela- culture of the spleen. Cover-glass preparations were likewise ive.

e will now return to those animals which had contracted swine le in spite of vaccination. The *post mortem* appearances of these ls (95, 103, 94) have already been given on page 485. In cover-

and was obtained in a condition of purity from each animal. In
ining the *post mortem* notes it will also be noted that they wer
acute and virulent cases. This is especially true of pig No.
none of them was there more than a mere beginning of ulce
the intestinal tract.

Of the four inoculations with pure cultures of the bacterium o
plague to be described farther on, the first did not prove quit
factory, from the fact that the check-animal died before either
inoculated animals. It will be seen, however, that this need not
sarily be considered as militating against our interpretation. T
periment is briefly as follows: Two animals (109, 113) were ino
November 20 each with 4^{cc} of a liquid culture from the blood of
94, one-half into each thigh subcutaneously. No. 113 was foun
December 21. The autopsy showed complete necrosis of the
membrane of the cæcum and colon for a distance of 2 feet.
this the membrane was dotted with isolated ulcers. These ulce
so deep that the serous membrane became inflamed. On each
the seat of inoculation a large whitish mass was found over 2.0
long and .5 inch thick. The spleen of this animal contained bu

e direct effect of the virus and were suffering from the indirect re-
lts thereof. The presence of large tumors at the points of inocula-
n indicates greater power of resistance on the part of these two ani-
ls than was shown by animals subsequently inoculated.

The healthy check-pig (No. 110) penned with these died December 6
er four or five days of illness, during which period the feces were at
aes covered with blood. The body was examined December 7. Skin
t discolored; the inguinal glands much congested; surface of spleen
vered with numerous red punctiform elevations; right heart dis-
ed with a dark semi-solid clot; two or three punctiform extravasa-
us on the auricular appendages; lung-worms quite numerous; lungs
rently normal, however; stomach deeply congested in fundus;
ds of mesentery much swollen, those of colon dark red; the mu-
of large intestine intensely inflamed throughout; no ulceration;
r ce of both kidneys dotted with numerous dark red points; medulla
dark. Cover-glass preparations of the spleen contain the oval bac-
num in small numbers. A gelatine tube culture of spleen and one of
od from the heart contains the same motile bacterium alone.

From the foregoing description we observe that the check-animal died
m a very acute attack, and it seems reasonable to suppose that it
ught the disease from the two inoculated animals, and, being the more
sceptible, quickly succumbed to the virus. The herd from which this
imal was taken did not allow any suspicion as to its soundness con-
l ng later observations. It is highly probable that the disease ap-
red early in the inoculated animals, but owing to its comparative
dness remained unnoticed for a time. The cultures from No. 110
re successful in demonstrating the presence of the oval motile bac-
rium. Compare with this the negative results of the chronic cases.

Two mice, inoculated November 10 as above, with a bit of spleen from
No. 94, were found dead December 6, one of them drowned. The
er had a very large spleen while the kidney was quite pale. A cov-
s preparation each of spleen, kidney, and liver, contained no bac-
A liquid culture from blood contained the oval bacterium, pure,
ver. November 25 two mice were inoculated hypodermically with
out five drops of a liquid culture of the blood of pig No. 94. Novem-
28 one was found dead. The lungs were very much congested and
k in water. No bacteria discernible in cover-glass preparations of
een, kidneys, and lungs. The second one died December 3; spleen
ged, medulla of kidney very dark, lungs œdematous, reddish. The
cteristic oval bacterium present in very large numbers in cover-
preparations of spleen, kidney, liver, lungs, and heart's blood. A
uid culture from the same found pure when tested on gelatine plates.

Two pigs (Nos. 96, 97) were fed November 18 with the intestines of
o. 94. No. 96 had a temperature of 105¾° F. on November 21; diar-
a set in on the following day and continued until death, which oc-
red quite unexpectedly on November 24. The *post mortem* appear-
s were in brief as follows:

Superficial inguinal glands very large, œdematous. In the abdomen
nsiderable quantity of straw-colored fluid. Vessels of stomach, mes-
ry, and large intestine very full; glands of mesentery considerably
ged, somewhat reddened. A few punctiform extravasations on
auricle. Scattered extravasations under pulmonary pleura. Bron-
and mediastinal glands enlarged and very dark red. Mucous
ne of cæcum of a dull purplish hue with very thin scattered
s of necrosed tissue. At the base of the valve the flask-shaped
s distended with yellowish-white plugs.

gland, exhibited the usual features of pure cultures of the
on the following day. This was confirmed by finding them
and when line cultures were made on gelatine plates of
colonies derived therefrom resembled one another, as well
the previous cases. All cultures prepared from this case the
pure and alike.

Cultures in tubes of gelatine of heart's blood and splee
were equally successful, that of blood containing a modera
that of spleen a very large number of colonies. Two liquid
the blood, one from the spleen and one from an inguinal
tained the same motile bacterium in a pure condition as sh
cultures.

In these, as in many preceding and subsequent experimen
pleasure in pointing out the fact that liquid cultures are no
demned, for with proper tubes and sufficient care pure cult
variably obtained, and as such the contained bacteria are
cessible to study than those buried in the depths of the g

A bit of spleen from pig No. 96 was put under the skin
November 25. One of them was found dead December 7.

erately enlarged; lungs somewhat congested. Bacterium in cov- of spleen, kidney, liver, and lungs. A liquid culture of blood from heart was found pure. In No. 33 the spleen was very large, medulla idney very dark red. Several highly-congested areas of lungs; erium abundant in spleen; few in kidney, liver, and lungs. A liquid ure of blood from the heart found pure as above.

o mice (Nos. 29 and 30) received under the skin of the back a bit ieen from pig No. 97 on November 28. Both were alive and well mber 22, when they were killed with chloroform. The spleen of one but slightly enlarged; that of the other was from three to four s its normal size. No bacteria were found in either.

ere was but one rabbit at our disposal at the time of these experi- s. This animal had been at the station for many months. On No- ber 27 it was inoculated by a hypodermic injection into each thigh out 1^{cc} of a liquid culture from the spleen of pig No. 96, found pure. as found dead December 1. On examination the spleen was found ged, very dark, and friable; substance of liver and kidneys equally Right heart filled with a dark clot. Left heart contained a small e clot extending into the large vessels. The stomach contained two clots, each as large as a walnut. In the middle region, along the er curvature, the mucous membrane was intensely reddened and d with dark spots of extravasated blood, the probable place of the rrhage. Cover-glass preparations of the spleen contain immense bers of the oval bacterium, the liver less, the kidney still less. were also found in the lungs. Gelatine-tube cultures of the spleen blood from the heart grew precisely as the former cultures. Two l cultures each of spleen and blood contained the motile bacte- . Line cultures on gelatine proved each of them pure. This case ed so conclusive that the want of additional rabbits was not felt riously at the time, although it would have been of great interest termine whether the hemorrhage into the stomach is a constant phe- non, since it is not infrequent in pigs, while inflammatory affec- of the mucosa seem to be the rule in acute cases.

o pigeons were inoculated December 3 with a liquid culture from pleen of pig No. 97. No. 1 received about $\frac{1}{2}^{cc}$ under the skin of ight shoulder. No. 2 received about $\frac{1}{2}^{cc}$ under the same place and ldition 1^{cc} beneath the skin near the keel of the sternum. No. 2 within twenty-four hours. There were no lesions perceptible, ex- ng a deeper red of the pectoral muscle at the point of inoculation. r-glass preparations of spleen, liver, and kidney negative. As t have been expected from such a large dose, the bacterium was nt in the viscera and blood, as determined by pure liquid cultures ood from heart and liver tissue. No. 1 appeared ill on the follow- lay. It remained quiet on its perch, with feathers ruffled; feces ely white until December 8, when blood was passed, mixed with s. This condition lasted until December 12, when it was found . There was no somnolence noticed at any time, and symptoms ting to an implication of brain and spinal cord absent.

examination, the right pectoral muscle appeared as if the blood been soaked out and the muscle boiled. Its consistence was that oil flesh. This condition prevailed over the major part of the muscle for a depth of about three-quarters of an inch. Liver very soft; spleen and lungs normal in appearance. The large ne for a distance of about 6 inches from cloaca appeared distended covered with yellowish spots about one-eighth of an inch in diam- The greater part of the mucous surface was covered with a dark

brownish necrosed layer interspersed with yellowish masses. Cover-glass preparations of the spleen, liver, and lungs contained large numbers of the oval bacterium; very few in blood of heart and in kidney. Two cultures in tubes of nutritive gelatine, one inoculated with blood from the heart, the other from the liver, showed the characteristic growth of the bacterium after two days. The colonies were very numerous and crowded in the culture from the liver; few and scattered in that from the blood. Two tubes of meat infusion peptone inoculated, one f the liver the other from the blood, were found pure cultures of this motile bacterium when grown on gelatine plates.

On November 27 two pigs (Nos. 111, 114) were inoculated by a cutaneous injection of a liquid culture made from the spleen of pig No. 96, and found to consist of only one kind of microbe, when tested by cultures on gelatine plates. The microbe was motile, grew on g like that isolated from previous cases, and was presumably the mic of swine plague. The culture medium consisted of a sterilized in of beef with 1 per cent. peptone. About 1.5^{cc} were injected into thigh. On December 5 the temperature of one of the animals (No. 114) was 103.3° F. Bowels somewhat loose at first. Appetite good death, which took place between 9 and 12 a. m., December 6, about days after inoculation.

The examination was made December 7, a temperature below t ing preventing *post mortem* changes. The superficial inguinal gl were found considerably swollen, the section dotted with red p and lines. The spleen was somewhat enlarged and darker than mally. The right heart distended with dark, imperfectly coagul blood. On both auricular appendages a number of well-marked ex vasations, some the size of a pin's head; on endocardium of left h few, not larger than mere points. Lungs œdematous and of a pale dish hue, especially marked along the edges of the lobes. Bron glands enlarged, of a dark-red color throughout. The glands at root of the mesentery and about stomach very large and confluent, o mottled appearance. On section the medulla hyperaemic. On t apart the coils of the large intestine the glands of the meso-c peared as purplish red bean-shaped bodies gorged with dark Beneath the serous coat of the cæcum at its very tip were nume punctiform extravasations. The kidneys were severely inflam the surface of both, numerous punctiform extravasations. On the pyramids, including the tips of the papillæ, of a dark red color. cortical portion dotted with innumerable dark red points. The l phatic glands in the abdomen itself were of the same purplish color. examining the mucous membrane of the intestinal tract, a large, d reddened patch of mucous membrane was found on the greater ture of the stomach. The small intestine seemed intact excepting the ileo-cæcal valve, where the longitudinal folds were of dusky brought about by aggregations of minute dark-red points. A si condition prevailed throughout the large intestine, giving the surface a dark appearance. In many places small, blackish ecchy indicated hemorrhages on the surface. The kidneys in this seemed to have suffered most severely, next to the large intestine, in all our examination was obviously the seat of the severest

Cover-glass preparations of the spleen, kidney, and liver, e immediately, revealed the same microbe which had been introduc the system.

Cultures in tubes of gelatine from blood of the heart and s assembled precisely the pure cultures from previous cases. As

ies in the culture of the blood were few and scattered; those in pleen culture were innumerable in each needle track.' (Plate II, 3.) Two liquid cultures inoculated with blood from the heart and rom the spleen were tested as above and found pure, containing the motile bacterium.

e second pig (No. 112) inoculated with the same culture and in the manner as No. 114 died in the morning of December 12. The erature first rose to 105¾° F. on December 8; diarrhœa set in on mber 10. It was found dead on the morning of December 12. The ns closely resembled those of No. 114 with the following differ- s: The spleen was much enlarged, gorged with blood, and very le. On one border there were prominent red points, giving it a ed appearance. Numerous ecchymoses beneath the endocardium e left ventricle. On the surface of the lungs numerous dark-red s corresponding to hepatized lobules. These, about one-fourth of an in diameter, were found throughout the lung tissue. The kidneys, gh congested, were not so seriously affected as in No. 114. For t 4 inches from the valve the summits of the folds of the mucosa um were deep red, consisting of aggregations of red points. A large n of mucosa in the cæcum purplish. The large intestine, in gen- congested and covered with dark-red points. No ulceration. The gement of the lymphatics and inflammation of stomach, as in pre- ng case, but more severe, the mucosa of the greater portion having st a black color, due to extravasation. Cover-glass preparations of pleen contained but few specimens of the bacterium of swine plague. cover-glass preparation, each, of an inguinal gland, hepatized lung, l from heart and liver negative. Two gelatine cultures, as well as liquid cultures, grew precisely as those of No. 114 and preceding s; the liquids were found pure cultures of the motile bacterium as e. We had thus produced the disease from liquid cultures in two and had obtained from each pure cultures of the bacterium which been introduced into the system. After inoculating Nos. 112 and a third healthy check-pig, No. 111, was placed in the same pen. animal remained well for two weeks after the death of the second al, when it began to show signs of disease. It died December 31, than a month after being penned with Nos. 112 and 114. The psy demonstrated swine plague with extensive ulcerations of the intestine and implication of the lymphatic glands, lungs, and ach. No bacteria were found in three cover-glass preparations of pleen. This animal, therefore, remained well until infected by the inoculated ones. It is evident that no check-animal will remain nately intact, owing to the manner of infection, and hence this must e looked for in experiments with swine plague.

ecember 16 two guinea-pigs, female, were inoculated from the second d culture of the spleen, pig No. 114. No. 1 received $\frac{1}{3}^{cc}$ into each n. No. 2 $\frac{1}{3}^{cc}$ into one thigh. Both were sick on the following day, ching together and breathing heavily. No. 1 died December 18, at , No. 2 some time during the night.

both animals there was a considerable enlargement of the thighs, ulated, and of the surrounding parts. This was especially notice- in No. 2 when the inoculated side was compared with the other. was also a bluish discoloration of the skin extending to the vulva to the mammæ. In both a sero-sanguineous effusion extended from bli of inoculation in the subcutaneous tissue as far as the thorax. es of the thigh were infiltrated with blood. The vessels of n were greatly distended, forming a deep-red, arborescent net-

work. The skin itself, as well as the fatty tissue, was discolored b travasations; the abdominal wall was penetrated by blood extra tions, especially marked on the serous surface. In No. 1 this cond prevailed on both sides of the body. A coil of intestine lay in co with the abdominal wall, which was covered with extravasations vessels of the mesentery of this coil appeared like broad streaks of b The bacteria had, without doubt, penetrated the abdominal wall invaded the vessels of the contiguous mesentery. In No. 2 only side of the body which received the injection was affected. The phatic gland of the opposite groin was already invaded, howeve shown by a deep red color of the gland and a paler red of the surro ing layer. A few vessels were found on the same side with spi shaped enlargements. In both animals the lungs were distended on section much reddened. Right heart distended with a dark coronary vessels very full.

In cover-glass preparations of No. 1 the bacteria were found abundant in the subcutaneous effusion and in the kidney, less a dant in liver and spleen. In No. 2 they were found in large numbe the effusion and in the spleen; they were moderately abundant in liver, kidney, and lungs.

From the above it would seem that guinea-pigs are highly ble to the virus of swine plague, though quite insusceptible to rouget, as shown by foreign investigations. A very small amo the virus might have shifted the disease to the internal organs produced less extensive lesions near the point of inoculation. T lation and rupture of blood vessels seem to point to a rapid mult tion of the bacteria within them.

The lesions may possibly suggest the presence of malignant o to which guinea-pigs are very susceptible. The absence of the of this disease, however, and the enormous numbers of the bacter swine plague present in the subcutaneous effusion effectively con this supposition.

The cultures made from these two animals were all successful. in a tube of gelatine from the blood of the heart and liver of N showed the minute colonies in the needle track in two days. They exceedingly numerous in the liver, few in the blood. Three cultur liquid media from the spleen, liver, and blood respectively were on gelatine plates and found to contain the motile bacterium i lated. From guinea-pig No. 2 gelatine cultures from the kidney liver, respectively, and liquid cultures from the liver and blood heart were tested as above and found pure.

Three mice were inoculated at the same time with the same cul No. 34, quite small, received two drops; No. 35, four drops; No six drops; No. 34 was dead the next day. No. 36 died Decembe spleen very large, containing the introduced bacterium in large q ties. No. 35 active December 28; this one had been inoculated some tissues from swine plague about six weeks previous.

On the following day, December 17, two fowls, Nos. 16 and 17, inoculated from the same culture. Each received 1^oo, one-half on side of the keel of the sternum subcutaneously. Both were well cember 26. When killed on that day, the site of inoculation on un ner surface of the skin was deeply reddened by an injection of the vessels. On the surface of the pectoral muscle, the injection w intense. In one case the surface of the muscle was dotted with form ecchymoses. The deeper portions of the muscle were not

reaction in the birds was quite severe and suggests the local mul-
cation of the injected bacteria to a considerable extent.
wo pigeons (Nos. 3, 4), were inoculated December 10, with a culture
t forty-eight hours old, in beef infusion peptone, from the spleen of
No. 114. No. 3 received $\frac{1}{3}^{cc}$ subcutaneously near the keel of the
num. No. 4 received $\frac{1}{3}^{cc}$ in the same place and an equal quantity
: the right shoulder. No. 3 showed no signs of illness for three
ks after. No. 4 became ill within a day after inoculation. Its
hers became ruffled and it remained very quiet. It seemed to have
vered December 23, when it was killed for examination. At the
of both inoculations large sequestra, about 2^{cm} long and 1^{cm} thick,
e found imbedded in the pectoral muscle, consisting of necrosed
cular tissue. They were grayish and separated from the living tis-
by a tough, whitish membrane. Both were readily removed.
this experiment both birds resisted successfully, the one receiving
larger dose being made sick for a time.
wo additional pigeons (Nos. 5, 6) were inoculated December 21 with
quid culture about nine days old from the spleen of pig No. 112. No.
ceived 1^{cc}, one-half being injected subcutaneously on each side of
keel of the sternum. No. 6 received one-half of this dose in the same
ner. No. 5 was found dead next morning. Cover-glass prepara-
s of the spleen and liver contained no bacteria, the time being too
f for their abundant multiplication in the various viscera. No. 6 be-
slightly sick the next day. On December 27 its feathers were very
n ruffled, and its head drawn in. The bird was killed with chloro-
n December 28. When the feathers were removed the crop was found
rely empty, the animal quite emaciated. There was a large tumor
ach side of the sternum at the place of inoculation, and confluent
r its anterior portion. Beneath the skin each appeared as a triangu-
yellowish-white elevated area about 2^{cm} square; on section it ex-
ed from 1^{cm} to 2^{cm} into the pectoral muscle. This mass of muscular
e appeared as if boiled, resembling that of pigeon No. 1 exactly.
ne viscera, the liver and kidneys were gorged with blood, especially
latter. The lower portion of the intestinal canal, examined with a
, was found injected and dotted with numerous dark red points. It
ery probable that if the animal had been allowed to live the intes-
would have presented the same appearance as that of pigeon No. 1.
er-glass preparations of the internal organs were in general nega-
as far as regards the active multiplication of the organism. Liquid
ures of the liver, kidney, and blood from the heart, when tested on
es of gelatine, contained the motile bacterium of swine plague.
tures from the changed pectoral muscle were equally successful.
culture from the liver contained in addition a microbe having on
tine a very active surface growth, contrasting markedly with the
wth from the three remaining cultures which were pure. In this
nal, the local reaction, which was very severe, evidently acted as a
rier to the invasion of the microbes. There were too few in the in-
al organs to be detected in cover-glass preparations, while the cult-
test proved adequate to demonstrate their presence.
n December 5 two pigs (Nos. 121, 140) were inoculated with a pure
culture, about seven days old, from a superficial inguinal gland
No. 97, each receiving about $3\frac{1}{2}^{cc}$ of the culture liquid. On De-
r 10 the temperature of No. 121 rose to $107\frac{1}{2}^{\circ}$ F. It was found
quite unexpectedly on the morning of December 12, having eaten
ly the evening previous. To summarize briefly the *post mortem*

the same organ gave the characteristic minute colonies in l
bers. The check-pig (No. 122) placed with this pair on t
oculation died on the same day with No. 140. It had probau
fected by No. 121, as it had succumbed very suddenly, and th
revealed a very acute case of swine plague of the hemor
Lungs, intestines, and lymphatic glands were severely dise
had not yet formed. The spleen contained the oval bacterium
dance, as shown by cover-glass preparations and a culture i

With the same culture which had been injected into pig
and 140, two fowls were inoculated on the same day, Decembe
received $\frac{1}{2}^{cc}$ of the culture liquid beneath the skin on each s
keel of the sternum. Both fowls remained under observati
weeks without revealing any symptoms of disease.

On November 28 two pigs, Nos. 98 and 99, were fed with the
of No. 97. No. 98 had been at the station nearly six weeks a
well. The temperature, at the time of feeding, 102½°, rose t
November 30, but fell to 104½° December 3. December 5
began to fail very rapidly, and died during the night.
tion no discolo tion of the skin; superficial inguinal

tches. The glands between the coils of the large intestine of a purplish-red. The cæcum and neighboring portion of large intes- closely studded with superficial ulcerations of varying size, some wish, others with a jet-black center surrounded by a yellowish bor- This center probably represents the remains of the blood extrava- as leading to the ulceration. In cover-glass preparations of the n and liver, the same oval bacterium was present in moderate num-

In a gelatine tube culture each of blood from the heart and of spleen, the characteristic colonies appeared very numerous in the n and moderately so in the blood. Liquid cultures from the same es were found to contain the motile bacterium only and to have haracteristic growth on gelatine.

case of No. 99 the temperature likewise rose to 107½° F., on Novem- 0. It died on December 7. The lesions resembled those of No. 98, the following exceptions: In the left side of the abdominal cavity ge clot of blood was found beneath the peritoneum, extending from the diaphragm into the pelvis and representing probably 300cc of l. The left kidney was entirely imbedded in it. The place of rupt- ould not be found, owing to the firmness of the clot. Both kidneys

Glands of the intestinal tract prominent, but very pale. In the ach the food there present was encased in a dark coagulum. The orrhage probably came from the base of the folds at the fundus, e the mucosa was very dark red. In the cæcum and large intes- the mucous membrane was studded with jet-black pigment-patches cted into lines and groups. The valve was covered with these ec- oses showing signs of ulceration. This condition prevailed through- he large intestine; the rectum seemed intact. Echinorhynchi in l intestine. The oval bacterium found on cover-glass preparations e spleen in moderate quantity. Two cultures in tubes containing ine were prepared, one from blood taken from the heart, the other the spleen. In forty-eight hours a small number of whitish points present in the blood culture. In that of the spleen, however, each le-track contained a large number of these minute colonies. In ad- n to these there were in all five colonies distinguished from the rest eir large size. Two cultures in meat infusion peptone inoculated blood from the heart, when tested on gelatine plates, were found

A liquid culture from the spleen gave different results. The line e gelatine plate, along which the bacteria had been sown, was visi- s a white line in twenty-four hours, while the colonies of the bac- m of swine plague do not appear within forty-eight hours after g. The surface growth especially was quite vigorous, enlarging n three to four days into an irregular whitish band. The microbe nbled that of swine plague, but was larger and stained more deeply. liquid culture itself, when re-examined, was covered by a brittle brane. The tube culture in gelatine demonstrated that the strange obe was present in very small numbers in the spleen itself. This rates very clearly how one method of culture acts as a check on the , and how each contributes something to the determination of the . The presence of another organism in the spleen need not be very rising when we consider the severe hemorrhage mentioned above. ro pigs, Nos. 107 and 108, were allowed to feed December 9 upon the ch and intestines of No. 99. No. 107, after showing symptoms for a week, was found dead December 18. No. 108 lingered until ber 21, when it was found dead. In No. 107 there were a few In the cæcum and a large area of inflammation in the stomach. ymphatics in general were swollen and gorged with blood. Ex-

travasation on auricles of heart. The autopsy of No. 108 revealed a more extensive ulceration and inflammation of the large intestine. The lesions elsewhere were similar to those of No. 107. In the spleen of both animals the characteristic bacterium was found. No cultures made.

In the evening of December 5, two pigs, Nos. 120 and 145, were fed with four liquid cultures of the bacterium of swine plague and next morning with five additional cultures, each culture being equivalent to 10cc. These had all been tested on gelatine plates and found pure cultures of the same microbe. The source of these cultures were pigs Nos. 96 and 97, the rabbit and mice inoculated therefrom. The cultures were mixed with dry feed and were in this way readily consumed. December 10, No. 145 was somewhat dull, and had slight diarrhea, continuing until death, which occurred rather suddenly between 5 and 6 p. m. December 12, as it had eaten heartily in the morning. It was examined early the next day. No distinct discoloration of the skin; superficial inguinal glands tumefied and slightly reddened. In the abominal cavity, the peritoneum covering the intestines was faintly reddened, the vessels of the omentum distended and bright red. A small quantity of straw-colored serum present. The surface of the liver was covered with bluish-gray patches. The medulla of kidney, including tips of papillæ, very dark red; spleen dark, slightly enlarged; vessels of surface of heart very much distended.

In the stomach the mucous membrane of the fundus w , as
a very dark-red color. The severest lesions, however, a such
had not seen before, were found in the ileum and large int
about 3 feet from the valve the entire mucosa of the ileum was
stained yellowish, and could be scraped off with the scalpel. The
appeared as if macerated; the mucous membrane came away in
the lower part of the large intestine, the complete necrosis was
replaced by a dark-red membrane dotted with yellowish ulcers
fourth inch in diameter and not more than half an inch apart.
in the rectum ulceration was absent. The affected intestine was
thickened that it failed to collapse when cut open and contents
In this case the local effect of the ingested bacteria had been
overshadowing the lesions of the remaining viscera. Even
phatic glands, almost invariably and severely diseased in
ing cases were but moderately inflamed; those of the mesen
ever, were very much enlarged. The other animal, No. 1
day later. The temperature was but slightly elevated unt
12, when it reached 108° F. Great debility supervened until
cember 14. In this animal superficial inguinal glands were
larged, the cortical portion gorged with blood. Spleen enlarg
friable. A few ecchymoses on endocardium and epicardium.
lobules of the lungs dark red, hepatized, showing here and
travasations under the pleura. Both kidneys much swoll
dark red, numerous extravasations under the capsule. On
cortical portion dotted with closely-set dark points,
also congested. Lymphatic glands of mesentery very
meso-colon gorged with dark blood. The mucosa arou
and on its valve colored deep purple, the inflammation ex
some distance into the duodenum. The mucosa of the
(containing a few specimens of *ascaris*) was not diseased
the ileo-cæcal valve, where a small area was covered wi
extravasations. The cæcum and upper third of the large
the seat of extensive ulceration. The yellowish, su

r numerous, leaving but little of the deeply congested, purplish
nbrane exposed to view.
n this animal the effect of the bacteria was far less corrosive, but
inflammation of the kidneys and lymphatic glands more severe. On
glass preparations of the spleen of both of these animals, the
teristic bacterium was found, far more abundant in the latter case,
ver. In these cases, therefore, the feeding of pure cultures was
ncient to bring about a most severe type of the disease. A gelatine
e culture, each of blood from the heart and from the spleen from
h animals, proved pure. Likewise four liquid cultures from the same
rces; each contained the motile bacterium only; all grew alike on
tes, the colonies identical with those of preceding cultures.
On December 19 two pigs (Nos. 76, 118) were fed with about 30cc each
various pure liquid cultures from six to ten days old. Five of them
re from the spleen of pigs, one from a mouse. For a few days after
cember 23 the bowels of No. 118 were loose and the animal was dull
l off its feed; thence it continued to improve. It was killed Jan-
ry 7 when apparently well. The only evidences of disease were a
derate enlargement of lymphatics of abdomen, which contained a con-
erable quantity of straw-colored serum. In the lungs, which were
general of normal consistency and color, there were numerous puncti-
foci, of a dark red color. The cæcum and colon contained no ecchy-
s or ulcers; membrane pale. The walls, however, were much thick-
ed, so that they scarcely collapsed when cut open and emptied. This
ture recalled the condition of the colon in No. 145, which had been
l with cultures and in which the great thickening was accompanied
complete superficial necrosis. Spleen evidently free from bacteria,
shown by one culture and cover-glass preparations. It is highly
obable that the thickening of the intestine was due to the ingested
ltures, and that the animal was quite insusceptible.
No. 76, an old animal which had failed to take the disease before when
posed to it, remained unaffected after the feeding.
Quite different from most of the cases described was that of No. 89,
posed November 5 to the disease with those vaccinated with Pasteur's
enuated virus. It presented no very marked symptoms of disease,
cepting a slight elevation of temperature. November 23 both eyes
inflamed; it moved about with difficulty, and on December 5 it
evidently dying, so that it was thought best to kill it, which was
plished by a blow on the head. The skin of the abdomen was
vered with brownish, papery scales, which came away readily, expos-
g a perfectly clean, white skin. The superficial inguinal glands were
ry large, pale, and infiltrated with much serum. Spleen dotted with
w red points. Liver pale; on its surface, small, yellowish patches
re and there. They cut like cartilage and formed the walls of small
sts, containing a soft, brownish pulp. Small portions of the lungs
nverted into a dull red, hepatized tissue, probably due to the pres-
ce of numerous lung-worms. Heart normal. Lymphatic glands of
ntery and meso-colon very large, but pale and tough. Stomach
small intestine apparently normal. About one-half of the large in-
ine, including the cæcum, was studded with yellowish ulcers, closely
mbling those depicted on Plate I.
This case corresponded closely with those which had come under our
vation for more than a year past. All inflammatory processes
apparently subsided, leaving nothing but the extensive intestinal
ions as witnesses of the former presence of the disease. Even
icous membrane surrounding the ulcers was pale, so that any one

unacquainted with the lesions of acute, fatal cases might infer that the disease in general was a purely local one, attacking the mucous membrane at the place of ulceration. It is highly probable also that in such cases the pathogenic microbe has been eliminated, or has given way to other sceptic microbes, which, gaining admission through the intestinal ulcers, may live, if not multiply, in the body. The spleen which furnished us quite invariably with pure cultures from the acute cases described above, and which, according to cover-glass preparations and gelatine cultures, contained the bacterium in abundance, failed in this case. Two liquid cultures, inoculated with a platinum wire, plunged into the parenchyma, remained sterile. A third tube, into which a small piece of the spleen tissue had been dropped, likewise remained clear. It is evident that if even a single germ had been present, one of the tubes would have been clouded. It is needless to add that cover-glass preparations of spleen tissue were equally negative. Three mice, inoculated with a bit of the same organ, were active three weeks later.

Among those cases in which swine plague was definitely made out on *post mortem* examination may be mentioned No. 88, which was exposed to the disease with No. 89, November 5, and died November 16. Cover-glass preparations of the spleen revealed the presence of numerous microbes, slightly longer than the bacterium of swine plague and without the light center. Cultures in gelatine from the spleen and heart's blood grew more rapidly than pure cultures, the surface growth being especially vigorous. Liquid cultures from the blood, when tested by line cultures, showed the characteristic growth of the bacterium of swine plague; but there were, in addition to these, a few smaller colonies growing like them, so few in number, however, that they were regarded as retarded colonies of the same microbe, their small size excluding a microscopic determination.

On November 27 a mouse, which had been inoculated with a spleen from this pig November 16, was found dead. It had been ill since the inoculation. The eyes were closed; the amount of tion very slight. The glands of the groin enlarged, serously infilt The acini of the liver were pale and bloodless, its substance very Spleen enormously enlarged, reddish, mottled. Kidney showed whitish patches, half as large as a pin's head; on section the lary portion was deeply congested and well marked off from the cortical portion. Both liver and spleen very soft and friable.] œdematous, but float in water. They presented on the surface im sions of the ribs and very minute interlacing, red lines, as of inje vessels. Cover-glass preparations of the spleen, liver, kidneys, lu and blood from the heart all contained the oval bacterium of s plague in profusion, the paler center well marked in all preparat The culture in gelatine from the spleen presented innumerable m colonies in the track of the platinum wire. The liquid cultures i the spleen and heart's blood both contained an oval, motile bacte The cultures were opalescent, without surface membrane. Both t pure when tested by line cultures on gelatine.

On December 2 another mouse, which had been inoculated with one just described, and kept in the same jar, was killed with chlo m. The organs presented the same appearance as the one just cr he spleen also of enormous size. Strange to say, no bacteria were n any of the internal organs, but a liquid culture of the blood ained the motile bacterium and was pure, as determined by li ures. This animal had been inoculated sixteen days before.

um of swine plague, not obtained pure from the pig, was thus isolated passing through mice.

n another case, No. 100, in which the mucous membrane of the :um was a single mass of necrosed tissue and most of the other ons found in swine plague were present, cover-glass preparations the spleen, blood, and a few lymphatic glands were negative. One iid culture of the blood and two of the spleen remained sterile. A tinum wire, dipped into the blood and spleen substance, was drawn ough layers of gelatine on plates. Not a single colony appeared. e animal penned with the former, No. 101, also died of swine plague, iown on *post mortem* examination, but complicated with a localized itonitis in the region of the liver. The liquid cultures from the itoneal effusion and blood grew more vigorously than swine plague cteria, and on gelatine the colonies remained very small. In several er attempts at plate cultures, they entirely failed to grow. The crobe resembled that of swine plague. In both pigs (Nos. 100 and .) the common bile-duct was completely occluded and greatly dis- by about ten ascarides, extending from the duodenum into the aller bile-ducts. This may account for the peritonitis found in No. . The fact that it is difficult to demonstrate the presence of the bac- ium of swine plague in chronic cases which have lasted more than ee weeks, and in which the ulcerations in the large intestine are eady far advanced (Plate I) cannot be emphasized too much. In ose cases in which the disease leads to a sudden fatal termination, the cterium, as a rule, is found abundantly in the spleen. Ignorance of ese facts has no doubt led to previous erroneous deductions in investi- tions on the etiology of this disease. Chronic swine-plague must ceforth be looked upon as an after stage, independent of the disease f id caused by intestinal lesions, the indirect result of the growth of) cterium in the blood vessels of the mucous and submucous tissue. t terium has already disappeared from the stage and makes way quently for other either harmless or septic microbes, which gain en- ce through the ulcerated membrane and are found in the blood and ous exudates. An epidemic of swine plague, which broke out among herd of pigs destined for experimental purposes, illustrates the gen- al statement above very well. This epidemic which, most fortunately, peared after the experiments recorded in the preceding pages had en completed, and cast no doubt on the results obtained, was very vere and showed the great mortality in herds in which the disease gained a foothold. The disease was, without doubt, introduced th the herd, and the lesions found on *post mortem* all pointed to chronic ses of three or four weeks standing. Of twenty-five animals exposed the disease only two remained well. All the diseased animals died in riods varying from two to four weeks after exposure. Each case was refully examined and cover-glass preparations made from the spleen every animal. Out of fifteen animals only two had a few bacteria the spleen. Of but three of these liquid cultures were made, for ant of time. These three remained sterile. This is very significant hen we compare with these latter results those obtained from acute s. It goes far to prove that the majority of the animals affected swine plague die from the sequelæ of the disease, and but few from e direct effect of the microbes multiplying in the blood vessels of the ternal organs.

It is hardly necessary to recall once more the important fact that in l these cases no bacillus resembling that found in Pasteur's vaccine, d proved to be the cause of rouget on the continent of Europe, ever

appeared to us in cover-glass preparations or in cultures. In his first communication on rouget, Pasteur speaks of the microbe as fatal to rabbits and sheep, but not to fowls. Having satisfied ourselves that it killed rabbits, but had no effect on fowls, two lambs were inoculated December 31 in each thigh, No. 1 with 2^{cc}, No. 2 with 1^{cc}, of a liquid culture from the spleen of pig No. 112, now nineteen days old. On January 3 the temperature of No. 1 had risen to $106\frac{1}{2}^{\circ}$ F. In both there was considerable stiffness in the hind limbs, no desire for food. No. 2 was killed January 13, after having almost recovered. At the places of inoculation small abscesses had formed. The neighboring lymphatics were enlarged. The viscera seemed intact, excepting the spleen, which was dotted with numerous small red patches resembling extravasations. A bit of tissue therefrom contained no bacteria.

The other lamb was also nearly recovered. On each thigh two small abscesses had formed.

A calf was inoculated hypodermically at the same time with 4^{cc} of third liquid culture from the spleen of pig No. 114. Its tempe
rose from 103° to 106° F., which it reached January 2, when a swelling
perceptible in front of the shoulder where the injection had been
The temperature slowly fell afterward. The animal was killed for
other purpose January 13. The swelling, as large as a hen's egg,
found to implicate the muscular tissue into which the needle no d
had penetrated. When incised, an irregular cavity was found wi
the muscular tissue lined with a soft pultaceous mass, arising fr
crosis of the muscle substance. A superficial lymphatic gland
was considerably enlarged.

THE BACTERIUM OF SWINE PLAGUE.

In at least twenty-five cases of undoubted swine plague, bits of tissue, when spread out in a thin layer on a cover-glass, dried and st
in some aniline color, were found to contain the same microbe in gr
or less abundance* (Plate II, Fig. 1). When stained for from one to two minutes in an aqueous solution of methyl-violet† and examined with a Zeiss $\frac{1}{18}$ homog., they appear as elongated ovals, chiefly in pairs. greater number present a center paler than the periphery. This may be due to a greater density or staining capacity of the peripheral po
The darker portion is not localized at two extremities as in the ba
of septicæmia in rabbits, but is of uniform width around the entire circumference of the oval. The length of an oval in balsam pre
is about 1.2 to 1.5 micromillimeter; its width, .6 micromillime

* During the past year much time and labor were spent in examining section
from intestinal ulcers, enlarged lymphatics, and hepatized lung tissue. The
contained, as might have been expected, various forms of organisms. Even
deeper portions away from the necrosed regions no two ulcers were alike as
the bacteria found therein. Sometimes micrococci would be found in abu
the inflammatory infiltration. At other times long, slender filaments would
adjacent blood vessels and extend into the healthy area. Ova from the *tri*
were quite constantly found in the base of the ulcer; some were imbedded am
cellular elements near the edge of the ulcer. Sections of enlarged lymphatic
showed an engorgement of the lymph sinuses with blood corpuscles. Bacteri
absent. Sections of lung-tissue were equally negative or contradictory. As
terial examined came from chronic cases the result need not be very surp
what has been stated concerning the presence of the bacterium of swine pl
spleen in acute and chronic cases. It is our intention to subject the m
tained from acute cases to a thorough microscopic examination from which
sults may be expected.

† The bacterium from liquid cultures when stained with aniline water, methyl-vio
et, and decolorized with iodine according to Gram does not retain the stain well.

onally forms are observed longer than this (1.8 micromillimeter) somewhat more slender; in these also there is a noticeable differnce between the central and the peripheral portions in the intensity of ne stain. (This difference is not an optical effect, for it is only seen after he bacteria have been stained and are examined without a diaphragm. t is well known that large pencils of light efface details of structure and ring out those depending on differences in the intensity of the color.)

In liquid media the bacterium is *motile;* its movements recall those f *bacterium termo.* When moving to and fro the pairs of bacteria are pt to revolve about the point of division in such a way that each indiidual describes the surface of a cone. That it is not *bacterium termo* is roved by the fact that it does not liquefy gelatine and that not the lightest putrefactive odor is emitted from any culture containing it.

The bacterium under cultivation shares, with many other bacteria, he property of varying slightly in form in different media, and at diferent periods in the same medium. Cultivated in meat infusion with per cent. peptone for forty-eight hours, the average size of a bacterium vas .9 micromillimeter in length, and .4 to .5 micromillimeter in width.

In meat infusion peptone gelatine they are larger than in cover-glass reparations from the spleen. Occasionally a very long filament may e seen lying amongst the ovals and short rods. These vary from .8 cromillimeter to 1.8 micromillemeter in length, and are about .7 microllimeter broad in cultures forty-eight hours old.

The value of dimensions must not be overestimated. They are at est somewhat variable. The size of a microbe which is constantly ndergoing division must vary with the activity of multiplication, hich in turn depends on the amount of nutritive material at hand. [ence in a rich medium, at an early period of growth, microbes mulply faster, and the forms are relatively smaller than in less nutritive edia, or in such in which the food material is nearly exhausted. This t least agrees with our own observations. In cultures of the swine lague bacterium in chicken broth, probably the poorest of meat exacts, slender filaments of considerable length were frequently observed. he culture was suspected of being impure, but when tested on plates o difference among the colonies could be observed. Moreover, these had an abnormal appearance never seen in vigorously growing ili. They often bore dilations and constrictions, and their extremis were poorly defined. They were also characterized by very slugn movements.

In all cultures we have determined the purity of cultures not by one ut by several characters. The most important of these are: (1) The low growth and absence of liquefaction in nutritive gelatine; (2) the ppearance of the colonies of the bacterium on gelatine plates; (3) its orm and motility in liquid media.

In neutralized liquids, such as extracts or infusions of beef with or thout peptone, the bacterium multiplies very rapidly, so that tubes, noculated with a minimum quantity of blood, &c., containing it, are nvariably turbid on the following day. This turbidity is greatest in uids rich in nutritive matter, such as those containing peptone. In ple meat extracts the liquid remains merely opalescent. On shaking tube a considerable flaky deposit is seen in a few days after inocuon. There is at no time a distinct membrane observable on the sur- of the liquid, although, when tubes remain very quiet for a time, a ow whitish ring is apt to be deposited on the glass at the surface the liquid. This band, consisting solely of bacteria, is sometimes entire, sometimes limited to a small portion of the circumference of the

tube. It is densest in neutralized meat infusion to which 1 per cent. of peptone has been added, and appears in the form of whitish downy masses which are readily shaken down into the liquid. On the surface no confluent membrane forms, but occasionally a small patch, resembling the band just described, is seen floating on the surface of the liquid. This band cannot be homologized with the membrane formed by other bacteria, such as that of *bacillus subtilis*, since it is not constantly present and forms only after several days or a week. It must be looked upon merely as a deposit of the bacteria similar to that formed on the bottom of the tube at the same time.* At the end of two or three weeks the sediment, consisting entirely of very short rods or ovals, does not stain well. Only a narrow line of color indicates the outlines of the individual microbes. It might be claimed with Klein that these are spore-bearing forms. This, however, has not been confirmed. On the other hand, our experiments on the thermal death point, given below, oppose this view.

When sown on gelatine plates, either scattered or in lines, the colonies may be detected with a low power after forty-eight hours. They are nearly spherical, with pale disk and sharply-defined margin. In another day they are visible to the naked eye as mere points. Examined with a 1-inch objective they appear irregularly oval, egg-shaped, or spherical. The margin is a well-defined dark line, the disk brownish in color with transmitted light (Plate II, Fig. 2 *a*). When growing on the surface, the colonies appear as patches somewhat refrangent (Plate II, Fig. 2 *b*). The center being elevated, the whole forms a very flat, irregular cone. The border of the colony is irregular, very thin, and pale.

While examining liquid cultures by sowing them in lines on gelatine plates, we observed in every line a few very faint, cloudlike bodies, which were evidently situated near the lower surface of the gelatine, or between it and the glass. These colonies (Plate II, Fig. 2, *c*, *c'*, *c''*) were much larger than the spherical forms, the center slightly opaque and margins gradually vanishing. We at first suspected the presence of another microbe, but how could two microbes be present in a liquid culture in the proportion of 1 to 100 or more? When examined microscopically they resembled the bacterium which was in the majority. Yet this method was not satisfactory, since it was difficult to get access to the deeply buried colony. Finally, we came to the conclusion that the bacterium of swine plague grew in this way when deposited on the glass. To prove this, we dried thin layers from a liquid culture upon glass plates and poured the gelatine upon them. In forty-eight hours we found the plates covered with these pale, nebulous colonies; only a very small number were round. As the film had not been thoroughly dry, some bacteria may have worked their way into the gelatine and there developed into spherical colonies.

There is another feature of the nebulous colonies which suggested to us the identity of the two forms of growth. In Figure 2 *c''* a nebulous colony is drawn with a spherical form above but communicating with it. At first sight the spherical form seems to have burst and discharged its contents, which represent the nebulous form, the true explanation being that the same colony grows up into the gelatine and laterally over the glass. Figure 2 *c'*, represents another form of colony very frequently observed, in which the connection between the two parts does not appear, but undoubtedly exists below. Owing to a lack of time, it has not

* We have lately observed in a few tubes which stood undisturbed over a week, a more or less complete surface membrane, composed of very brittle fragments.

ossible for us to see whether other microbes, which do not liquefy
e, grow in this way on plates. Whether they do or do not, the
is quite important, and it seems that in future the morphology
nies, not only within the layer of gelatine and on its surface, but
ıder it, must be studied, if this method is to be continued as a
of testing the purity of cultures and determining species.
ubes containing nutritive gelatine, these bacteria appear in the
f very minute colonies within two or three days, which enlarge
ghtly beyond mere specks (Plate II, Fig. 3). A very thin, whitish
ing layer is usually present on the surface of the gelatine at the
of inoculation, limited to about a millimeter in its surface exten-
These minute colonies invariably appear in those cases in which
:sence of the swine-plague bacterium was determined from cover-
reparations, and their appearance was alike in all respects. When
.ture contained also other bacteria, these usually multiplied more
; in the needle track, and the colonies resulting therefrom stood
large as pins' heads among mere points. The surface growth was
ıs a rule, more vigorous and thick; whitish layers were formed.
:n much crowded, the colonies of the swine plague bacterium re-
uite small, while those that are scattered grow considerably larger.
lo not exceed half the size of a pin's head even under the most
ble circumstances. This is readily seen in each tube culture, in
the lowest point of the needle track contains only isolated colonies,
ıear the surface they are fused into a single mass. This fact must
: borne in mind in estimating the purity of the cultures, as it is ob-
; impossible to subject every section of the needle track to micro-
examination. We have found the colonies from the blood almost
ıbly larger than those from the spleen, chiefly because they were
; few in number, and also because a small quantity of blood was
ıced upon which the bacteria seem to thrive much better than
he nutritive gelatine.
w additional facts may be mentioned which need further inves-
n, however. In *milk*, sterilized by discontinuous boiling, the
ium multiplies without producing any change in the appearance
milk itself. Two cultures kept for three weeks remained un-
:d; when sown on plates the well-known colonies grew as usual
:re as abundant as in beef infusion peptone. In two tubes, con-
; respectively 3 and 1.8 per cent. of non-neutralized Liebig's meat
t, the bacterium multiplied rapidly and abundantly. This extract
acid reaction. The bacterium of swine plague, therefore, unlike
rouget, is not limited to slightly alkaline media, but may grow in
:hat contain a small portion of acid as well.
)oiled potato the bacterium grows very well. It seems to be a far
substratum than beef infusion peptone gelatine. The bacterium
:sts growth by first staining the white cut surface of the potato
place of inoculation with a chocolate color, gradually turning
lark and spreading over the entire surface. In the latter stage
mbles the discoloration frequently observed on boiled potatoes
ng for a day or two. The growth itself begins in the form of small
masses which gradually unite into a patch $\frac{1}{2}^{mm}$ to 1^{mm} thick. This
reads slowly by lateral extension and its straw-colored, slightly
rface contrasts strongly with the dark, bluish-red background
o. This description applies to growth at a temperature of
80~ r. In the incubator, at 95° F., the multiplication was more
nd abundant.
rows well in liquid and solid blood serum sterilized by discontin-

uous heating at 58° C. In the latter medium its growth remains limited to the track of the needle, forming there a cylindrical body not more than 1^{mm} thick after a number of weeks. The lower, free end of this slender plug is somewhat enlarged into a knob. On the surface of the serum it spreads out as a very thin whitish layer. No liquefaction takes place.

Thermal death-point of the swine-plague bacterium.—Four tubes were exposed to a temperature of 58° to 60° C. for about two hours. They contained liquid cultures varying in age from one to four weeks. When fresh tubes were afterwards inoculated from these, three remained sterile, the fourth contained a bacillus. It was evident from this that the bacterium had been destroyed. The presence of the bacillus may be accounted for by the water of condensation formed in the upper portion of the tube during the heating which had washed down some spore. This experiment having been made for another purpose, the death-point was again determined as follows:

Two tubes each, of nutritive liquid (one, meat infusion with one-half per cent. sodium chloride, the other meat infusion with 1 per cent. peptone), were inoculated from four pure liquid cultures from different animals and one, two, three, and four weeks old respectively. Before inoculating the tubes they were raised to 58° C. After inoculation they were exposed, four at a time (one from each culture), to the same temperature for ten minutes, then cooled off quickly in cold water. Seven tubes remained permanently clear, the remaining one, from a culture three weeks old, became turbid on the fourth day and contained the bacterium which was introduced.

The thermal death-point must, therefore, be set down at about 58° C. The fact that the cultures of all ages from one to four weeks succumbed at this temperature, demonstrates the absence of any resistant spore state, such as that found in *bacillus subtilis* and *bacillus anthracis*.

It is a very important point to determine whether the virulence of pathogenic bacteria is lost during artificial cultivation. To determine this point the following experiment deserves to be recorded:

A culture in beef infusion peptone, made December 7 from the spleen of pig No. 114, was used to inoculate a potato December 21 on which it grew at a temperature of 65° to 80° F. quite luxuriantly. January 6, one month after the microbe had been taken from the body, a liquid culture was again prepared from the material on the potato. On the following day three mice (Nos. 37, 38, 39) received hypodermically 7, 5, and 3 drops, respectively, of this liquid culture. No. 39 died January 10. Bladder greatly distended, hemorrhagic spots over its surface. Slight ecchymosis at the point of inoculation. No bacteria on cover-glass preparations of the spleen. As there was some doubt about this case no cultures were made. Nos. 37 and 38 found dead January 14, one week after inoculation. Both had been sick for several days previous. In No. 37 there was a whitish degeneration of the muscular tissue at point of inoculation, and slight injection of the surrounding t
Spleen slightly enlarged, almost bloodless, friable, crowded with bacterium of swine plague; kidneys congested and containing the bacteria in large numbers. In No. 38 the lymphatic glands of the fold very large; spleen about 1 inch long, three-eighths of an wide, and nearly one-fourth of an inch thick, very dark. It might been mistaken for a lobe of the liver it was so large. The vessels o part of the mesentery were distended with blood which had infiltrated the tissues for a short distance around them. The bacterium of swine plague was found in spleen and kidneys, other organs not ex Lungs in part deeply congested and sink in water. A liquid from the heart's blood of each was turbid next day with t
erium injected.

As mice seemed on the whole more refractory than rabbits or guinea-
gs, we inferred that the virus, though a month old, had not yet lost
original pathogenic power.

A large number of problems remain to be solved concerning the mor-
ology and biology of this organism. One of the most important, with-
t doubt, is that of obtaining a vaccine by reducing the virulence of the
cterium and maintaining it at a certain "strength," as has been done in
e case of anthrax, and presumably *rouget*, by Pasteur and his cola-
rers. If this problem shall ever be solved, and it is our intention to
dertake it immediately, it must be based upon as large a horizon of
ts concerning the life-history and physiological activity of the organ-
n as can be obtained by existing methods. We are fully aware that
s problem is an exceedingly difficult one. The difficulty is increased
the peculiar character of the disease itself, its communicability among
perimental animals, which require the utmost care, in order to be
otected from incidental infection. Even when this is exercised the
ease will sometimes spring up where least expected.

GENERAL RÉSUMÉ OF THE PRECEDING INVESTIGATIONS.

The earlier work recorded in the preceding pages aimed to determine
at relation the bacillus cultivated by Pasteur as a vaccine for *rouget*
re to the disease among swine prevailing in this country. At that
ne the bacterium of swine plague had not yet been seen by us, owing
e fact, determined later, that long-standing, chronic cases of the dis-
—the only ones which had come under our observation thus far—
e comparatively free from the germ that had produced the disease.
The two vaccines prepared under the direction of Pasteur were care-
ly examined microscopically, by cultivation and inoculation into
ce. The microbe therein contained was a very small bacillus, which
ew in a characteristic manner in nutritive gelatine and was fatal to
ce. The bacilli were usually found imbedded within the leucocytes in
ge numbers. A number of pigs inoculated with this vaccine were
nd susceptible to swine plague, for when placed with diseased ani-
s for a short time four out of five contracted the disease and died.
the organs of these animals not the bacillus of *rouget*, but a peculiar
cterium, was found, which was subsequently proved to be the cause
the disease. It is now certain that *rouget* and swine plague are dif-
ent diseases, produced by totally different microbes, and that the em-
yment of Pasteur's vaccine is worse than useless, as it not only fails
protect but may spread a disease which we believe does not exist in
is country.

The bacterium of swine plague proper was found, as a rule, quite
undantly in the spleen of acute, rapidly fatal cases by means of cov-
glass preparations. Occasionally it was found by this means in lym-
atic glands, while its presence in nearly all viscera was demonstrated
several instances by the more delicate test of cultures. In acute
s the cultures were almost invariably pure, whether liquid or solid
edia were employed. In long-standing cases the cultures remained
erile when the disease was mild. When ulcerations were extensive
ey were peopled with several kinds of bacteria, whether inoculated
om the blood or serous exudates. From such cultures it was very
fficult to isolate the specific bacterium, owing to its slow growth on
latine. From two to six pure cultures of the same bacterium were
tained from about fifteen cases of undoubted swine plague. Its pres-
ce in the spleen of at least ten additional cases was determined micro-
opically.

The bacterium of swine plague has been fully described in the preceding pages as to such properties which have been studied. It is a motile bacterium, found chiefly in pairs. Each individual resembles an elongated oval about twice as long as broad, the length being about 1.2^{m} to 1.5^{m}. It is quite easily stained by the aniline colors. It grows readily in neutral, slightly alkaline, or acid infusions of meat, with or without peptone; more slowly in nutritive gelatine which it *does not liquefy*. It grows very well on boiled potato and blood serum, as well as in milk. It varies somewhat in size when grown in different media. It is killed in liquid cultures by being exposed to a temperature of 58° C. for ten minutes. Spores are probably not formed. The effect of prolonged drying has not yet been determined.

Of six pigs inoculated subcutaneously with pure liquid cultures of this bacterium, all died of swine plague. In four of these animals the same bacterium, which had been introduced into the system, was obtained in cultures from the spleen and heart's blood. The indentity of the microbe from the different animals was determined microscopically by culture methods and inoculations. Of four pigs fed with pure liquid cultures two contracted the disease in a very severe form. Of the remaining two one had failed to take the disease when exposed before; the other was sick for a time but recovered. In those fed, the intestines were most severely diseased; in those inoculated hypodermically there was in most cases a hemorrhagic inflammation of the kidneys.

A number of pigs were fed with the viscera of those which had died of swine plague. They all contracted a rapidly fatal form of the disease, and the same bacterium was found in the spleen and blood of these animals which had been obtained from the organs which they had consumed.

Mice proved quite susceptible to this bacterium. In at least t
which died from inoculation the oval motile bacterium was
There is usually some local reaction at the place of inoculation,
fested by a whitish appearance and a soft, friable condition of the
sues involved. A very frequent lesion is the great, at times eno
enlargement of the spleen, and the enlargement of the glands in the
knee fold. Less frequently the medullary portion of the kidneys and
the lungs are found deeply reddened. When bits of spleen from s
were placed under the skin of the back, the disease lasted from
to sixteen days; when cultures were injected, from five to eight
This difference is, without doubt, due to the difference in the n
of bacteria introduced into the system. In some of the an
which the disease was prolonged bacteria were present in bu
numbers. This may be explained by regarding the animal as ha
almost overcome the disease. In such cases, moreover, the spleen
exceedingly large, indicating a slow but constant irritation leading
hypertrophy. Only a very small proportion of the animals inoc
with bits of spleen survived, while the cultures were invariably
In a large proportion of cases the bacterium was found in the s
liver, kidneys, blood from the heart, and lungs.

In the one *rabbit* at our disposal death occurred about four days after inoculation with the pure culture. The bacterium was shown pre
in the various internal organs by the microscope and cultures. The
only marked lesions were a great enlargement and congestion of the
spleen and hemorrhage in the stomach. In two *guinea-pigs* the virus
caused death in three to four days. The chief lesions were an extravasation and infiltration of blood in the connective and muscular tissue
about the place of inoculation, slowly invading the rest of the body.

he bacterium was evidently multiplying within the blood vessels and ıpturing them. The inoculated microbe was present in the internal rgans and very abundant in the local infiltration. In *pigeons* we have ound that .75cc of the culture fluid is almost invariably fatal. With maller doses there may be a very severe local reaction, terminating in he formation of extensive sequestra, or the microbe may invade the ıternal organs. In one case the lower portion of the intestine was exensively thickened and ulcerated. This bird seems to be on the border ine of susceptibility. Four fowls were insusceptible, the injection of ultures being followed by slight local inflammation merely.

In the two sheep and a calf the injection of pure cultures produced bscesses at the point of inoculation with elevation of temperature.

RESULTS OF LATEST INVESTIGATIONS.

More than four years ago,* in the study of the subject of insusceptiility to contagious diseases, the conclusion was reached that in those iseases in which one attack protects from the effects of the contagion ı the future, the germs of such maladies were only able to multiply ı the body of the individual attacked, because of a poisonous prinipal or substance which was produced during the multiplication of ıose germs. And also that, after being exposed for a certain time to ıe influence of this poison, the animal bioplasm was no longer sufficently affected by it to produce that profound depression and modifiıtion of the vital activity which alone allowed the growth of the pathogıic germs and the consequent development of the processes of disease. fter several series of experiments, made at that time with only negave results, it become necessary to suspend these investigations until oints connected with them, and which were then obscure, should be eared up, and until it should become possible to repeat the experients under more favorable conditions. Our expectations in regard to ıis important subject have at last been realized by the results of exeriments recently made in the laboratory of the Bureau of Animal Iustry.

The bacterium, which we have lately discovered and which we believe ı be the cause of swine plague, is killed in liquid cultures by an exsure to 58° C. for about ten minutes.

This method of destroying the bacterium in liquid cultures was reorted to in studying the effects on pigeons of the chemical products ptomaines ?) formed by the bacteria in their vegetative state, and which re probably dissolved in the culture liquid. The heated cultures used ı these experiments were always tested by inoculating fresh tubes ıerefrom, and, if no growth followed this inoculation, the death of the ıicrobes was considered established.

It had been previously determined that the subcutaneous injection of 5cc ($\frac{3}{16}$ dram) of a liquid culture of the swine plague bacterium conning 1 per cent. of peptone was invariably fatal, in the majority of ıgeons within twenty-four hours. One-half of this dose was fatal to a v only.

As a preliminary experiment four pigeons were inoculated December 4, 1885, with a liquid culture that had been heated for two hours at 8° to 60° C. Three of these (Nos. 10, 8, and 9) received simultaneously ', 8cc, and 1.5cc of the heated culture, respectively. The fourth (No. ı received 1.5cc of the pure culture liquid, into which no microbes had ı introduced. No. 9, the one which had received the largest dose,

* Department of Agriculture, Annual Report, 1881–'82, pp. 290–295.

was evidently sick the next day, but slowly recovered. The others did not show any symptoms of illness.

January 11, the one which had received a hypodermic injection of the simple culture liquid (No. 7), and the one which had received the largest dose of heated virus (No. 9), received subcutaneously about .75^{cc} each of a liquid culture five days old, which had been prepared from a potato culture fifteen days old. It is probable that this virus was not so strong, therefore, as a more recent culture from the pig would have been. Both pigeons were sick on the following day. No. 7 died seven days after inoculation. The bacterium of swine plague was found abundantly in the pectoral muscle, in the spleen, kidneys, and liver in moderate numbers.* The other pigeon (No. 9) slowly recovered, but had lost the use of its legs. It seemed perfectly well when killed, fifteen days after inoculation. It was quite fat, the crop filled with food. In the pectorals were found imbedded two elongated masses of dead tissue or sequestra about 2^{cm} long and 1^{cm} in diameter, entirely separated from the sorrounding tissue by a dense, smooth membrane. In this animal the multiplication of the pathogenic bacteria was purely local, the resistence of the tissues being sufficiently powerful to confine and finally destroy the bacteria. The sequestra were made up of dead muscular fibre, which was pale and parboiled in appearance. Each was enveloped by a more or less hyaline homogeneous layer. A liquid culture, inoculated with blood from the heart, remained sterile.

This experiment pointed evidently to an immunity obtained from the chemical products of the bacterium of swine plague. To confirm this view another experiment was made.

January 21, three pigeons (Nos. 11, 12, 13) received hypodermically 1.5^{cc} of heated culture liquid in which the bacterium of swine plague had multiplied for two weeks, and was then destroyed by exposure to 58° to 60° C. for several hours. A fourth pigeon (No. 14) was kept as a check. No. 10, which had received .4^{cc} of heated virus December 24, now received a second dose, this time of 1.5^{cc}. For the following three or four days all were somewhat ill, and remained rather quiet, with feathers slightly ruffled.

January 29, when all seemed well, three of the four (Nos. 10, 11, and 12) received hypodermically another dose of 1.5^{cc} of heated culture liquid. The other (No. 13) had been fiercely attacked by its fellows, and its head was so injured that it was thought best not to give it an injection at this time, and it was placed in a spacious coop alone. None of the birds seemed much affected by this dose.

February 6, a final injection was practiced upon the four, No. 13 having recovered from the effects of its injuries. The dose was, as before, 1.5^{cc}. All seemed well a few days later.

February 13, one week after the last injection, these birds were inoculated with strong virus, the quantity injected being .75^{cc}, which had hitherto proved invariably fatal, with the single exception of the bird that had been previouely treated with heated virus. Those inoculated were Nos. 10, 11, 12, and 13, which had received the heated virus, also No. 14, the check pigeon, which had not been touched, and No. 8, which had received a small quantity, 8^{cc} of heated virus, December 24, over fifty days before.

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* In this animal the major part of both pectoral muscles appeared as if they had been boiled; they were whitish, bloodless; the fibers could be easily broken or crushed with the forceps. The muscular tissue surrounding the dead portion was very dark, gorged with blood. The liver was dark in patches; spleen and kidney pale.

n the following day the check pigeon (No. 14) was found dead; the which had received the smaller dose (No. 8) was very ill and died be- the next day. The other pigeons were perfectly well. The effect iis dose of strong virus, so remarkable on the unprotected pigeons, even more evanescent than that of the heated virus in which all life been destroyed.

here can be no doubt, therefore, from this very positive result, that pigeons had acquired an immunity through the effect upon the tis- of the chemical products formed by the bacterium in the culture id.

. table giving the dates of the injections and the quanity introduced each animal is given below:

ons.	1885.	1886.				Total of heated virus.	Remarks.
	December 24.	January 21.	January 29.	February 6.	February 13.		
	Heated virus.	Heated virus.	Heated virus,	Heated virus.	Strong virus.		
	cc.	cc.	cc.	cc.	cc.	cc.	
)....	.8	.....	.....	.....	.75	.8	Died in forty-eight hours after injection of strong virus.
)....	.4	1.5	1.5	1.5	.75	4.9	Well February 20.
)....	.....	1.5	1.5	1.5	.75	4.5	Do.
)....	.....	1.5	1.5	1.5	.75	4.5	Do.
)....	.....	1.5	.....	1.5	.75	3.0	Do.
)....	.....	.....	.....	.....	.75	.....	Died in twenty-four hours after injection of strong virus.

ı the birds that died (Nos. 8 and 14) the pectoral muscles at the ɔe of injection were pale and friable. Necrosis was already at hand. ı internal organs were not macroscopically altered, excepting the ɔen of No. 8, which was enlarged and dark. The presence of the terium of swine plague in the blood from the heart was demonstrated liquid cultures, which, inoculated with a minimum quantity of blood, e turbid with this specific microbe on the following day.

he conclusions to be drawn from this experiment we believe are of erlative importance to a correct understanding of the phenomena of tagious diseases, and the methods by which these diseases are to be ıbated. They probably apply to all bacterial plagues of men and an- ls in which one attack confers immunity from the effects of that par- ılar virus in the future. These conclusions are:

l) Immunity is the result of the exposure of the bioplasm of the ani- l body to the chemical products of the growth of the specific microbes ich constitute the virus of contagious fevers.

2) These particular chemical products are produced by the growth the microbes in suitable culture liquids in the laboratory, as well as he liquids and tissues of the body.

3) Immunity may be produced by introducing into the animal body chemical products that have been produced in the laboratory.

THE DISEASE AS OBSERVED IN SWINE.

ns during life.—The disease may last from a few hours to four ın tal cases. Quite frequently animals will die very suddenly

without warning. Some of these cases (pig No. 94) present the hemorrhagic type of the disease very distinctly. In the majority of cases which came under our observation recently, the disease lasted from one to two weeks. The most prominent symptoms are those of great debility and capricious appetite. In about one-half of the cases, diarrhea set in after three or four days. The feces are usually liquid, at times blood-stained. In those cases where ulceration is extensive, diarrhea is always present. The rectal temperature is usually high, but variable and not at all reliable as a means of determining the intensity of the disease.

Lesions observed after death.—Discoloration or reddening of the skin is quite rare. When present, it is usually found about the genitals in both sexes. The subcutaneous fatty tissue is frequently of a diffuse redness and rarely studded with small extravasations.

The peritoneal cavity usually contains more or less straw-colored serum in advanced cases. In those which die quite suddenly serous effusions are absent. The coils of the intestine are now and then covered with a few fibrinous, stringy coagula, indicating slight peritonitis. Beneath the serous covering of the intestines extravasations of blood are quite common in very acute cases. They are most frequently encountered on the large intestine throughout its entire length or limited to the cæcum. Occasionally a few coils of the ileum are covered with punctiform ecchymoses. They are found now and then on the stomach. Only once did we see large ecchymoses in the fatty tissue surrounding the kidney.

The spleen is usually considerably swollen, dark, gorged with blood, and very friable. On its surfaces and borders, in acute cases, raised blood-red points are frequently encountered. The liver is sometimes enlarged, sometimes highly congested, and is found quite pale at other times. Occasionally its surface is mottled with pale greenish patches. The kidneys are more or less changed. In those animals inoculated hypodermically as well as in a few others, they were very large. Frequently the surface is dotted with a variable number of dark-red points, is commonly much congested; even the tips of the papillæ may assume a dusky hue. The cortical portion in some cases is the seat of a hemorrhagic inflammation. On section it is dotted with closely set, dark-red points, probably the glomeruli in a state of extreme engorgement.

The heart is but slightly affected. The pericardium is always more or less distended with fluid. In acute cases a variable number of punctiform and larger extravasations are present beneath the epicardium of the auricular appendages. More rarely a few are found beneath the endocardium of the ventricles. The right side is, as a rule, distended with a dark coagulum and left nearly empty.

The lungs are in many cases normal, both in cases of rapid death and protracted disease. We have seen many cases in which perfectly sound lungs accompanied extensively ulcerated intestines. In a moderate number of acute, virulent cases, the lungs are, in general, collapsed and pale. Under the pleura, however, there are seen small patches of a dark red color, which correspond to limited regions of dark hepatized tissue not much more than one-quarter inch in diameter. These foci are always found throughout the lung tissue in greater or less abundance. In the advanced stages of chronic swine plague, the major part of the lungs may be completely hepatized. This condition we have found but rarely, and may depend on circumstances not yet clearly understood.

The lymphatic glands are always more or less affected, those of the thorax as well as those of the abdomen. The glands at the root of the

ntery are very much thickened and confluent, mottled red, and sh; the medullary portion is commonly reddened, the cortex more ently gorged with blood. The glands imbedded between the coils e large intestine are usually of a very dark red. When these s torn apart, the glands are brought to view as isolated, bean- n bodies, their dark, blood-red color contrasting markedly with adjacent paler, flesh-colored serosa. This congestion prevails ghout the gland-tissue. On section the knife becomes covered blood. This description applies equally well to the glands in the n of the stomach, the paler inguinals, the bronchial, and mediasti- glands. In chronic cases, which have lasted from three to four s, the lymphatics are usually large, but very pale and tough on on.

e intestinal tract is ordinarily the seat of the most severe lesions. e stomach the fundus or most dependent portion is deeply reddened, blackish in color, depending on the amount of extravasated blood. sionally clots of blood are found forming a coating around the food. der cases the inflammation may be absent or replaced by isolated s. The duodenum is rarely affected. The jejunum seems to enjoy l greater immunity. The ileum is less exempt from pathological ges, which seem to be proportional to the extent and severity of esions found in the adjoining large intestine, which will be first ribed.

cases of sudden death the mucous membrane of the large intes- is deeply congested throughout. In a comparatively small num- f cases this inflammation is limited to the mucous membrane on ound the ileo-cæcal valve. At the base of this valve there is a n in which are imbedded the flask-shaped glands described by n. The mouths of these may be plugged with mucus, and there be, in addition, yellowish points and patches on the valve (the be- ings of ulceration), imbedded in a livid membrane. When the large tine is deeply congested, points of blood extravasation are usually ent, and the redness itself may be made up of aggregations of points. Clots of blood are occasionally found among the feces, h may themselves consist of altered blood. In more advanced s, pigment spots are occasionally found in lines and groups. These s may be surrounded by a yellowish, necrosed border. Such be- ing ulcerations are not frequent. The black blood-clot, surrounded zone of yellow, necrosed tissue, suggests the genesis of ulcers from orrhagic foci. In still older cases the dark red membrane is stud- with dirty, yellowish excrescences or ulcers, varying from one-eighth inch in diameter. In cases of very protracted disease, the inflam- ory redness of the membrane has subsided, leaving the roundish, ou-like ulcers upon a pale background (Plate I), or large areas may overed with a continuous, ragged mass of dead tissue.

sions of the ileum are either entirely absent or limited to areas of tiform, reddening with occasional extravasations. In the average of swine plague there is an abrupt change observable when the e is slit open, the dark, injected, brownish, ulcerated membrane of cum on the one side, the pale mucosa of the ileum on the other, ted by the free border of the valve. In but three of about fifty lid we find ulceration. These are fully described in the preced- pages (pigs Nos. 105, 140, 145). In two of these (Nos. 140, 145) the was produced by inoculating and feeding pure cultures of the ium of swine plague. We lay some stress upon this fact, as it entually prove the means of distinguishing this disease from

rouget, which prevails abroad, but most probably does not exist in this country.

Swine plague and typhoid fever.—Recent investigations* have shown quite conclusively that there is constantly present in the internal organs of persons who have died of typhoid fever a short bacillus, about three times as long as thick, equivalent in length to one-third the diameter of a red blood corpuscle (about 2.3 micromillimeters). This bacillus is spore-bearing, and does not stain so readily as most bacteria. It is motile, but does not liquefy gelatine. It grows on potato and in blood serum. Injected into rabbits, mice, guinea-pigs, and pigeons it produces no effect whatever. In comparing with this organism the bacterium of swine plague we are at once set at rest as to the non-identity of the two diseases. These organisms resemble each other in that both are motile and fail to liquefy gelatine. They differ in size, in the habit of forming spores, and in the manner of growing on potato. More important than this, however, is the difference in the effect on the lower animals. The bacterium of swine plague is fatal to guinea-pigs, rabbits, mice, and pigeons, in the order named. The bacillus of typhoid fever has no effect on these animals. What the effect of the bacterium of swine plague would be in the alimentary canal of man is a matter of extreme importance to the public health, but cannot be determined experimentally from the nature of the case. That it would have some disturbing effect is highly probable.

OTHER INVESTIGATIONS OF ROUGET AND SWINE PLAGUE.

In Pasteur's first communication on *rouget* (*Comptes Rendus*, 1882, XCV, pp. 1120, 1121) he describes as the cause of the disease a microbe having the form of a figure-of-eight and resembling the microbe of fowl cholera, but smaller and less easily seen. He speaks of it as being easily cultivated. It kills rabbits and sheep, but has no effect on fowls. In a second communication, made about a year later (*Loc. cit.*, 1883, XCVII, pp. 1163–1169), he confirms the statements made in the preceding c nication and describes the methods which he adopted to obtain uated virus or vaccine. If a series of pigeons, which are suscepti the virus, be inoculated, one from the other, the virus obtained f last pigeon is more potent than that derived from swine. If, in way, a series of rabbits be inoculated, the virus from the last the series is much weaker than the original virus from swine, and the latter are inoculated with it they do not die, but are made sick henceforth are protected from the disease, or, in other words, vacc It is established beyond a doubt by our own investigations and others during the past year that the microbe looked upon by the cause of the disease, and cultivated for purposes of vaccina bacillus which cannot be described as a figure-of-eight form by any It would be interesting to know whether the original microbe d by Thuillier is not really identical with the form which we have desc as being the cause of swine plague, and which in general appears the form of a figure-of-eight when obtained directly from the spleen properly stained. It remains still to be determined whether the dis known as *rouget* and swine plague exist together on the cont they do it is highly probable that Pasteur has studied two micro

* Gaffky: *Zur Ætiologie des Abdominaltyphus. Mittheilungen a. d. Kaiserlichen Gesundheitsamte.* Bd. II, S. 372.

:erium of swine-plague corresponding to the form which he first de-
ribed.* It is idle, however, to speculate whether Pasteur actually
udied two kinds of microbes until we know whether the form of swine
.ague prevailing in this country exists in France also. Klein's exhaust-
e report on swine plague (Seventh Annual Report of the Local Gov-
nment Board, 1877–'78, supplement, pp. 168–281), though excellent
; regards histological and pathological details, need not be considered
ere, as the methods adopted in the bacteriological investigations were
ich as cannot command our confidence to-day. We have already
ointed out the fact that in advanced cases of swine plague the perito-
eal cavity, thoracic cavity, and even blood taken from the heart con-
ain various kinds of bacteria. This fact Klein did not perceive, nor
oes he mention it in a more recent publication. Suffice it to state that
e failed to cultivate or detect any bacilli in the spleen of animals suf-
ering from swine plague (*Op. cit.*, p. 219). Our own investigations show
iat the spleen contains the bacterium of swine plague, excepting in
ases of long standing disease.

In the more recent article mentioned above (*Arch. f. path. Anat.*, XCV,
384, pp. 468–485), Klein describes a new series of experiments on swine
lague in which he fails to produce the disease in pigeons, and regards
asteur's cultures contaminated with the microbe of fowl-cholera, be-
ise the latter considered pigeons susceptible. It is now evident that
asteur at that time was cultivating the bacillus of *rouget*, which is fatal
pigeons. Klein describes in this article a new organism, differing
om the spore-bearing leptothrix-like bacillus first described by him,
hich was, without doubt, some contaminating microbe, although he
ils to perceive or acknowledge the difference. The new organism, as
r as we can gather from the text, resembles somewhat the one de-
:ribed in the preceding pages. It is motile, from 1 to 5 micromilli-
eters long, but is spore-bearing, a characteristic which the bacterium
swine-plague seems to lack. In cultures it is commonly 2 to 3 micro-
illimeters long, and appears either isolated, in pairs or in chains of
iree. According to his statement pigeons are wholly insusceptible to
. He, however, failed to define the characters more minutely by cul-
vation on different substrata, so that we are left in doubt whether the
icrobe liquefies gelatine or not, whether it multiplies on potato or in
ilk, and whether the liquid cultures made did actually contain but
ie kind of microbe.

The most recent investigations in Germany† concern themselves
iefly with the disease termed *Rothlauf* and identical with *rouget* in
ice. There is a tacit assumption that this disease and the one de-
:ribed by Klein as pneumo-enteritis (which is the disease prevailing in
iis country) are identical. It is hoped that in the preceding pages the
lical difference between these diseases has been permanently estab-
sned. There seems at present no reason for doubting the results of
ie foreign investigations which regard the delicate bacillus, cultivated
s a vaccine by Pasteur, as the cause of *rouget* or *Rothlauf*. In en-
eavoring to obtain from descriptions a clear idea of this disease as it
ists on the continent, we have found many lesions common to the two

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*From our own experiments but a small portion of pigeons seem susceptible to the
irus of the swine plague introduced beneath the skin in *minute doses*, while they in-
ably succumb to the bacillus of *rouget*.

†Löffler: *Experimentelle Untersuchungen über Schweine-Rothlauf, Arbeiten a. d. Kaiser-
en Gesundheits amte*, Erster Band. S. 46. Schütz: *Ueber den Rothlauf der Schweine
die Impfung desselben, Op. cit.*, S. 56. Lydtin u. Schottelius: *Der Rothlauf der
eine, seine Entstehung und Verhütung*, 1885.

diseases, but the characteristic changes almost invariably found in the large intestine are not mentioned at all by Löffler. The descriptions given by Lydtin and Schottelius leave us in doubt whether they did not actually study the two diseases at the same time. The presence of swine plague in England would naturally lead us to infer its existence on the continent.

In the animals examined by Löffler in the years 1882 and 1883, the fine bacilli were found constantly present in the skin and internal organs. Mice and rabbits usually succumbed to the inoculations, but pigs themselves failed to contract the disease when inoculated. The *post mortem* of a pig which was affected with the disease and killed by bleeding is given by him as follows:

> The skin of the entire abdomen, more especially in the axilla and inguinal regions, intensely reddened. Lungs of a rosy hue. Pharynx bluish-red; awns in the tonsils. Spleen enlarged, dark brownish-red, tough. Mucous membrane of the stomach and small intestine reddened, with numerous ecchymoses. Follicles enlarged. Mesenteric glands brownish-red, considerably tumefied, and studded with hemorrhagic spots. Parenchyma of kidney changed. Beneath capsule, as well as in the interior, numerous hemorrhages. Parenchyma of liver slightly clouded.

We miss here any lesions of the large intestine almost invariably found by us and carefully described by Klein.

In another pig Löffler (*l. c.*, p. 52), found extremely small, ovoid bacteria, recalling the organisms causing septicæmia in rabbits, especially those forms in process of division, although they were but half as large. These bacteria were obtained in a pure state from the skin, liver, and kidneys. The *post mortem* appearances were as follows: Skin of the abdomen, of the genital organs, and neck livid, red. Enormous œdema of the skin of the neck. Pharynx reddened and swollen. Mucous membrane of larynx and trachea intensely dark red. Lungs and heart but slightly affected. Parenchyma of liver and kidney clouded. Mucous membrane of stomach and beginning of duodenum intensely reddened. Intestine elsewhere normal. Mesenteric glands not enlarged. Inoculations with portions of the œdematous skin, liver, and kidney produced speedy death in rabbits, mice, and guinea-pigs. The virus differed in this respect from that of *rouget*, which does not affect the latter. The most prominent lesion in all cases was an extensive œdema of the subcutaneous connective tissue. This organism, cultivated through many generations on gelatine, was found fatal to these same animals six months later. Of two pigs, inoculated on abdomen and thigh at the same time, one died within forty-eight hours with enormous œdema of the subcutaneous tissue. The other pig remained healthy. The effects of this ovoid bacterium on guinea-pigs seem to be identical with those produced by the bacterium of swine plague. The disease, however, is clearly distinct from swine plague.

The experiments of Schütz confirm those of Löffler as to the relation of the fine bacillus to *rouget*. He produced the disease in two pigs by inoculation. One of them (female) received the entire contents of a Pravaz syringe subcutaneously on the inner aspect of the thigh. The other (castrated male) was inoculated by simply pricking the skin down to the subcutis five times with a needle of the syringe used in the previous injection.

At the end of the second day the temperature of both slightly elevated. On the morning of the third day they refused their food and were very weak. The skin of the pig inoculated with the pricks of the needle was faintly reddened everywhere, in some places quite markedly so. Pressure effaced the color for a moment. The animal receiving the

· dose had no marked discoloration of the skin. This animal died .e end of the third day. The *post mortem*, made on the following gave, in brief, the following: Bluish discoloration of the skin, as effusions into the peritoneal and pleural cavities. More or less ening of the mucous membrane of stomach and intestine, large and l, with occasional hemorrhagic spots. Bacilli present in the serous lates, in the blood, liver, kidneys, and lymphatic glands in moderate ber, very abundant in lungs and spleen. The other animal died a later. The lesions were very much the same, excepting that there e hemorrhagic spots and patches beneath the endocardium of the heart.

he same investigator also produced the disease in mice, pigeons, a rabbit. In the latter animal it assumed the form of a local ery- las at first, leading finally to death. In a more recent article (*Arch. iss. u. prakt. Thierheilkunde*, 1886, XII, 30–52) he gives the autopsy es of seven pigs which died of *rouget*. In summing up these cases ys (page 44):

all animals there were diseased the stomach, the intestinal canal (the solitary les and Peyer's patches), the mesenteric glands, the spleen, liver, kidneys, the t, and the skin.

n the notes of individual cases we observe that the skin was invari- bluish red. In the intestine ulcerations were absent, the large stine being nearly normal in every case. In the blood and spleen fine *rouget* bacilli were found in all cases on cover-glass prepara- ns.

he latest and most exhaustive work on *rouget*, in connection with ensive experiments with Pasteur's vaccine, is that of Lydtin and ottelius. (*Op. cit.*)

hey find that animals that succumb to vaccination present lesions kedly different from those which die of spontaneous infection. We te from page 21 concerning the intestinal lesions in spontaneous es (Lydtin):

ic solitary follicles, as well as Peyer's patches, appear quite distinct, especially the posterior extremity of the small intestine. Sometimes they have dropped so that real intestinal ulcers, especially in the region of the ileo-cæcal valve are ent, but only in small number. The contents of the large intestine are either l, or if this be not the case, blackish, fluid, resembling wagon grease. The mucous brane is also swollen, diffusely reddened in spots or patches. In many places ems corroded, brownish, and deprived of its epithelium.

here is no mention of ulceration in the large intestine. In the ani- s which died from the effects of inoculation with Pasteur's vaccine ut of 119) Dr. Schottelius determines (p. 206) that "the mucosa of intestinal canal is not altered. It is covered with intestinal mucus . normal feces and is pale, with the exception of a faint reddening r the ileo-cæcal valve."

n the autopsy notes of a pig infected in the natural way the same hor (p. 209) describes an extensive swelling and ulceration of Peyer's ches and the solitary follicles of the lower portion of the ileum: uch ulcers are also found in the upper portion of the large intestine, ceeding from solitary follicles, hence correspondingly smaller and ular." We have already called attention to the fact that in swine e the ileum is rarely implicated, and only in the severest cases, and the ulcerations in the large intestine are not confined to lymphatic es, but may involve the entire surface. This latter fact was pointed y Klein. He also states that he saw in but one case out of fifty ulcers in the ileum.

Whether the ulceration of the lymphatic structures in the ileum, on the one hand, and the necrosis of the mucous membrane of the large intestine on the other, are differential characters in the two diseases, still remains to be determined. In connection with the bacteriological investigations, Schottelius finds in cases of swine plague besides the fine bacillus, a larger one always present, resembling *bacillus subtilis*, and without the power of movement. This microbe grew quite well on gelatine and had no effect on mice, rabbits, and pigs. Its presence is explained by the author as being due to the ulcerations in the intestine through which it enters the system during life. Our own experience in dealing with swine plague is thus strikingly confirmed. We encountered not one and the same microbe, but many and different forms in the blood as well as in the serous exudates of chronic cases.

The investigations of Cornevin (*Premiere études sur le rouget du porc*, 1885) are marred by a want of precision in describing the specific microbe. If Cornevin had applied the recent methods of culture by which bacteria may be well characterized, some light might have been shed on the question whether both *rouget* and swine plague or *rouget* alone prevail in France. We limit ourselves to quoting all that is stated concerning the microbe of *rouget* in his monograph:

> If a drop of culture liquid from an advanced generation (*generation élevée*) is examined microscopically, it is found to contain large numbers of fine granulations, punctiform, or in the form of a figure-of-eight, refrangent, slightly motile, chiefly isolated, some united in pairs, threes, or fours. These granulations or cocci, which we have already seen in the blood, are the agents of the virulence, the specific microbes of *rouget*.
>
> In a series of generations *in vitro*, their form, originally varied, becomes regular and their dimensions uniform. In these conditions their multiplication seems to take place only by budding; on the side of the micrococcus there appears a bud which grows, and finally separates to undergo in turn the same process.
>
> But if the examination is made on recent cultures, particularly those inoculated with products from rabbit or rat, or with those from a pigeon affected with chronic *rouget*, one perceives rods, motile, short, with rounded extremities mingled with punctiform organisms.

From this description one might be induced to infer that Cornevin had under observation the bacterium of swine plague, rather than the bacillus of *rouget*. The absence of any other biological facts, however, makes any conclusion hazardous. Moreover the budding of micrococci must be looked upon with suspicion.

M. Baillet (*Recherches sur le rouget ou mal rouge du porc. Recueil de Médecine Vétérinaire*, 1884, p. 369), who also studied *rouget* in France, describes the microbe as being "in two oval sections, united in such a manner to give the whole the form of a figure 8." He speaks of it as being "endowed with great mobility." Here, again, we are reminded of the bacterium of swine plague, but this meager statement might describe a number of forms, including *bacterium termo*. Baillet succeeded in producing some disease in two guinea-pigs by inoculating cultures of this microbe. Death took place in ten days. The autopsy showed "congestion of liver and lungs, reddening of the intestinal mucosa; a congested state of the ganglia, and an injection of the peritoneum and the pleura, characteristic of *mal rouge*." Three rabbits, one dog, and two pigs failed to take the disease after inoculation.

Very recently an assistant of Pasteur's, Dr. Roux (*Comptes Rendus, Soc. de Biologie*, 1885, p. 684), in exhibiting photographs of the microbe of rouget, speaks of it as one of the smallest that have been d since its dimensions in the tissues do not exceed 1 to 2 micromilli In the blood, under an amplification not greater than 450, the or appears in the form of a very elongated 8 (*huit très allongé*). It

n that it appeared the first time to MM. Pasteur and Thuillier. writer could have spoken of it in this way while acknowledg- ne same time the work of Lydtin and Schottelius, who describe undoubted bacillus, seems incomprehensible to us. It appears le that any one acquainted with the appearance of the bacillus t in the tissues and cells of an affected animal or in liquid ould describe it under the form of an elongated figure-of-eight. ux and Schütz (*Loc. cit.*, p. 75) describe the microbe of *rouget* notile. Schottelius, who agrees with Schütz in almost every par- oncerning the characters of the bacillus of *rouget* and those of s vaccine, describes the bacillus as motile. We have not seen taneous movement in the cultures obtained from the vaccine, so feel inclined to believe that the cultures examined by Schot- ere impure.

erplexing and conflicting descriptions given by the French ob- are most charitably explained by assuming the existence of two undifferentiated diseases, that of *rouget* and swine plague It may be that the foreign bacteria frequently found in the in- gans in swine plague have contributed to the general confusion. e that animals suffering from swine plague have been invaded acillus of *rouget*, which is much more abundant in the various han the organism producing swine plague.

CONCLUSIONS.

receding investigations definitely settle certain controverted oncerning the etiology of swine plague, which may be briefly zed:

ine-plague is caused by a specific microbe multiplying in the the diseased animal. The microbe probably belongs to the cterium, and has the power of spontaneous movement. It is ltivated in nutritive liquids, but grows less readily on gelatine, does not liquefy.

nen introduced beneath the skin, this bacterium is fatal to pigs, guinea-pigs, mice, and a certain percentage of pigeons. It is l to pigs when introduced with the food or when they feed on nal organs of swine which have died of the disease.

e disease described in France as *rouget*, in Germany as *Roth-* for which Pasteur has prepared a vaccine, is caused by an en- fferent microbe. The vaccine for this disease does not protect swine plague.

e introduction of Pasteur's vaccine is not only useless, but may e to the introduction and spread of a disease, the existence of this country has not yet been demonstrated.

DESCRIPTION OF PLATES.

PLATE I.—Ulcerated cæcum of pig affected with swine plague laid open. The mu cous membrane of the ileo-cæcal valve is near the center of the figur and the small intestine with the cut end tied, above. The smallest ulcer are of a uniformly yellow color; the larger ones with zones of differen color, the largest, brownish or blackish in appearance.

PLATE II, FIG. 1.—From a cover-glass preparation of the spleen of a pig affected wit swine plague. Drawn with Abbe's camera lucida. $\frac{1}{18}$ homog. oc. (x 800); *a*, red blood corpuscles distorted; *b*, the bacteria of swine plague

FIG. 2.—Various colonies from gelatine plates. *a*, imbedded in the gelatine layer; *b* growing on the surface of the layer; *c c' c''*, growing between the gela tine layer and the glass plate; *a*, *b*, about five days old (x 73); *c c' c''* about seven days old (x 100); *a*, fails to give the idea of solidity. Th colony itself is either spherical or spheroidal; *b*, on the other hand, is flat tened; *c c' c''*, the margins gradually attenuate and become lost to view

FIG. 3.—Nutritive gelatine inoculated with a platinum wire from the spleen of pi No. 114; about three days old; natural size; *a*, the colonies developin from individual microbes.

FIG. 4.—Pasteur's second vaccine for *rouget;* dried on cover and stained in an aqueou solution of methyl-violet; mounted in xylol balsam; drawn with camer lucida (Abbe), Zeiss, $\frac{1}{18}$ homog. obj. ocular 2. The bacilli of *rouget* ar seen among the larger bacilli as slender curves or broken lines.

FIG. 5.—Drawn same as Fig. 4, cells from a dried cover-glass preparation from th lungs of a mouse inoculated with the second vaccine. Most of the bacill are within the protoplasm of the cells.

FIG. 6.—Culture in meat infusion peptone gelatine inoculated from plate cultures o Pasteur's vaccine I; 12 days old. The appearance is that of a row o faintly circumscribed, cloudlike masses in the track of the needle whic is itself scarcely visible as a delicate line. No liquefaction perceptible

SWINE-PLAGUE AND ROUGET.

OGRAPHICAL DISTRIBUTION OF SOUTHERN CATTLE FEVER.

uch time has been given to the collection of information in regard ne district permanently infected with Southern cattle fever, and the arks made in the First Annual Report of this Bureau as to the method pted and the difficulties encountered apply equally well to the work he past year. The section that has been investigated during the r is in many parts very sparsely settled; in some portions of it there been very little movement of cattle, and, consequently, there was y little information to be obtained; in other parts the continual driv- of cattle from the Gulf coast has often made it very hard to dis- inate between infection brought with these cattle and permanent ction, which may exist for year after year without fresh importation. believed that the results given below are as nearly correct as any t can be obtained at present.

ARKANSAS.

The unusual obstacles encountered in this State in collecting accurate ormation made it necessary to have two distinct investigations made oss the State by different inspectors. The facts which they collected, ile not in all cases indicating the same conclusion, have supplemented h other to such an extent that the line of the infected district may w be traced with approximate accuracy.

Beginning at the Mississippi River, it was found that the native cattle Mississippi County became infected by cattle driven in from farther ith, and died from Southern fever. Mr. W. Burroughs informed Dr. umbower that he had purchased cattle in Northeast Arkansas, in the nties of Craighead, Clay, Poinsett, and Greene, and had driven them Bates and Polk Counties, in Missouri, in the months of July and Au- st, that he had done this for the past six years, driving as many as e or six herds each year without causing any harm to native Missouri ttle. Mr. Reed said, "I don't want any cattle from south of Poinsett unty." A. T. Martin, of West Plains, Mo., introduced Southern er several years ago with cattle from Jackson County. W. M. Sum- rs has been dealing in Arkansas cattle since 1874. He has purchased in Poinsett, Craighead, Greene, Clay, Lawrence, Independence, l, Fulton, Baxter, Randolph, and Jackson Counties, but never knew to convey the disease to Northern stock. He has never heard of trouble arising from cattle that came from Mississippi County, Ar- as, or from Pemiscot or Dunklin Counties, Missouri. Mr. Moore, tle dealer of the same place, said he always had trouble with cattle were brought from south of Batesville, Ark. To illustrate this. id that several years ago he purchased 28 head of cattle 3 miles h of Batesville and drove them home; soon afterwards a number e native cattle sickened and died with Southern fever. Dr. Moore, 82, purchased 70 or 80 head of cattle in White County and drove to a range located 6 miles southeast of West Plains, Mo. This in the month of July. He kept them there two weeks and then e them into Northern Missouri. Soon after he left the range at t Plains, the native cattle died of Southern fever. In Vanndale and sburg, towns in Cross County, the native cattle still appeared sus- ible to the disease. In Saint Francis County, in the vicinity of For- ity and Wheetley, the ranges are permanently infected, and have

been for a number of years, and many of the native cattle are still susceptible and die during the summer months. At Batesville, in Independence County, and in the vicinity of Kensett, Judsonia, and Searcy, of White County, it was learned that animals brought from farther north almost always contracted this malady, and a large proportion of them died. A drove of cattle from Prairie County was taken to Marion County in 1878, and produced the disease among native cattle there. At Carlisle, Lonoke County, it was found that there was permanent infection which had existed in that vicinity for many years. In 1881, a herd of cattle from Faulkner County and adjoining districts were taken to Boone County and caused infection of native cattle there. At Saint Joe, Searcy County, 4 miles northwest of Marshall, in the same county, native cattle are infected and die as the result of feeding on pastures infected by Southern stock. No signs of permanent infection were discovered at these places. Cattle from Conway and Pope Counties caused outbreaks of Southern fever in Boone County in 1881 and 1882. Cattle from Jackson County caused disease in Boone and Carroll Counties in 1880 and 1882. A herd from Franklin County also infected animals in Carroll County. Crawford and Sebastian Counties are also infected, and animals taken to these counties from farther north contract the disease.

The reports from Washington, Madison, Boone, and Carroll Counties are more conflicting. They indicate that many places in these counties are permanently infected, and that loss of cattle occurs even when no new infection is brought there from year to year by Southern cattle. Other reports from Eureka, in Carroll County, and from Prairie Grove and Fayetteville, in Washington County, and from Bentonville, in Benton County, indicates that the pastures at these places are permanently infected, and that cattle contract the disease from grazing upon them, though no fresh infection has been introduced during the year. Cattle from Boonsborough, Washington County, carried the disease to Benton County some years ago. For many years cattle from the Indian Territory and Texas have been driven through Northwestern Arkansas on their way to market, and it appears that this constant renewal of infection has carried the northern limit of the infected district considerably farther northward in this part of the State than it is farther east.

Taking into consideration the facts that have been given above and many others that for lack of space cannot be enumerated, it would appear that the northern line of infection leaves the Mississippi River at about the southern boundary line of Mississippi County. This is very nearly opposite the point in Tennessee, on the Mississippi River, to which the boundary line of the infected district was traced in that State. Going westward, this line would appear to follow the southern boundary line of Poinsett County, crossing Jackson and Independent Counties, going a few miles north of Batesville, and then proceeds westward through Stone and Searcy Counties, leaving Mountain View and Marshall a few miles to the north. It then takes a more decidedly northwestern direction, crossing Newton and Carroll Counties, to Eureka, and is then directed westward to Bentonville, and from this town goes to the extreme northwestern corner of the State.

We have not been able to learn of any infected places north of t
line, and, as has already been stated, there are many localities
this line which are not permanently infected. Our endeavor
n drawing this line, as it was in drawing the line from the A
Ocean to the Mississippi River, to include all the permanently in
places; and while this may do some injustice to places south

ch are not permanently infected, it seems to be the only way in ich a line can be drawn which will give a correct idea of the northern ındary of the infected district.

INDIAN TERRITORY.

The facts that we have been able to collect in regard to Southern ver in the Indian Territory are mostly in regard to instances of the currence of this disease in the northeastern part of the Territory, incipally in the Cherokee and Creek Counties. Owing to the promis-ous driving of cattle through this section, it has been very difficult get exact information as to the cause of the disease in many of the ses. Sufficient observations of a definite nature have been recorded, wever, to show that the line of infection continues in a northwesterly rection from the northwest corner of the State of Arkansas, until it aches to within 12 or 15 miles of the Kansas State line, at a point arly south of Chetopa. Its direction is then westward across the ıerokee country and nearly half way across the Osage country. It en takes a southwesterly direction to the Texas State line, crossing e country of the Kiowas, Comanches, and Apaches.

At the Ponca Agency the native cattle are subject to infection from ttle from farther south, and Kansas cattle which are taken to Ponca gency do not contract Southern fever unless exposed to the infected ttle. The same appears to be true of nearly all of the territory em-aced in the Cherokee outlet. In the southern part of the Osage coun-y, and in all of the Creek country, cattle imported from Northern ates are almost certain to contract this disease, while the native cat-e mix with impunity with the Texas cattle.

It is reported as the general experience of stockmen in Arkansas and e Indian Territory, that long drives and close herding of cattle that e from the infected district, and are not usually susceptible to the sease, is an exciting cause of this malady, and large numbers of such ımals sicken and die during such drives. This has been particularly ticed with cattle from Southeastern and Eastern Arkansas which have en driven from there into the Indian Territory. These cattle, though ıdoubtedly from an infected section, contract Southern fever during eir journey, or soon after their arrival in the Territory, and many of em are lost from its effects. Facts of this same nature, observed in her sections of the country, have been referred to in former reports.

TEXAS.

For more than a year we have been collecting information in regard the occurrence of Southern fever in the State of Texas, and such other ta as would serve to indicate the extent of the district which may be nsidered as permanently infected. The lines of evidence to which we ve directed our attention are similar to those which have already been entioned in our investigation of this matter in other States, and for e information of those who are particularly interested in this question, it applies to Texas, I would state that there are six classes of facts serve as a basis of deciding this question. All of these are based three well-established conclusions, (1) that cattle from the per-ly infected district which are taken beyond this district, and infection does not exist, contaminate pastures, and in that minate the disease among the native cattle in the non-infected ; (2) that cattle from the non-infected district which are taken

into the infected district contract the disease and suffer with the same symptoms as those which contract it in the non-infected district from exposure to the infection of Southern cattle; and (3) that the native cattle of the infected districts enjoy an immunity from this disease, and, as a rule, do not suffer from it, either on their native pastures or when they have been driven into the non-infected section. In regard to any place in the infected district we should be able to establish one or more of the following facts:

(1) Cattle from here have caused disease.

(2) The native cattle of this section do not contract the disease.

(3) Cattle brought to this section from the non-infected section of the country contract the disease.

In regard to any place in the non-infected district we should be able to establish one or more of the following facts:

(1) Cattle from here do not cause the disease.

(2) The native cattle of this section, when pastured upon ranges over which cattle from the infected district have recently grazed, contract the disease.

(3) Cattle brought to this section from non-infected parts of the country do not contract the disease unless they have grazed upon pastures recently infected by Southern cattle.

There is a doubt in the minds of many cattlemen whether Texas cattle are dangerous from all that section of the State in which cattle brought from the Northern States contract the disease known as acclimation fever. In the States farther east, that have been pretty thoroughly investigated, we have not found that there was any material difference in the district indicated by these two classes of facts. We have found that wherever cattle suffered from acclimation fever, there the native cattle were capable of disseminating the disease. It is true that, as we approach the extreme boundary line of the infected district there are many localities which are not infected, and, even in those that are infected, the native cattle have not secured immunity, and consequently do not disseminate the disease. There is, consequently, a belt of country along this boundary line on which but a small proportion of the cattle are dangerous to those from farther north or west, but this belt is not many miles wide, and some of the cattle in it may be considered capable of infecting others. The emergencies which have arisen during the past year in regard to the movement of cattle from Texas, have made it very important that a preliminary line at least should be indicated across the State of Texas, which shall show the counties of the State that all attainable information leads us to believe are free from any permanent infection, and from which the cattle are in no sense dangerous to those of any other section of the country.

The following facts were collected by Mr. R. C. Saunders, jr., from different stock owners who have had experience with cattle in Texas:

Mr. J. F. Evans, of Sherman, Grayson County, Texas, stated that he had brought 160 fine cattle from Northern States to his ranch in Grayson County, near Sherman, and that one-half of these cattle have died of Southern cattle fever. He also stated that he had taken a number of fine cattle from the North to his ranch in the Pan-handle, and none of them had died from the disease. He has on several occasions driven large numbers of cattle from Erath, Grayson, Palo Pinto, Hunt, Fannin, Denton, Ellis, Hill, and Nevada Counties to his ranch in Donley County, and states that no disease was caused by them. In the summer of 1881 he took 6,000 cattle from Grayson, Hunt, Tarrant, and Denton Counties to his ranch in Donley County, and no disease re-

ed. Mr. Evans also stated that the native cattle in counties from ch these herds were driven do not contract the disease from the cat- hat are driven from the extreme southern counties of the State.
Ir. C. W. Smith, of Gainesville, Cook County, stated that in the ng of 1880 he had driven 300 cattle from his ranch in Cottle County Gainesville, and that on the road they had crossed the Southern as trail, and by this exposure 180 head were infected and died of thern fever.
Ir. C. C. Slaughter, of Dallas, Dallas County, stated that in May and ie, 1884, he drove 7,000 cattle from his ranch in Dawson County, on Colorado River, to the Cheyenne and Arapahoe Reservation in the ian Territory. They came in contact with a herd from Southern as, and 200 of the 7,000 died of Southern fever. He also stated that tle from the coast country will infect cattle on his range in Dawson nty, and that fine cattle from the Northern States do not contract disease on his ranch unless infected by Southern cattle.
Ir. Rue, of Sherman, Grayson County, stated that in 1873 he drove 00 cattle from the Concho River, in Tom Green County, to Pettis nty, Missouri, and that they infected the native Missouri cattle.
. J. T. Davis, of Colorado City, Mitchell County, said that in the ng of 1884 he bought 12 Kentucky bulls and took 10 of them to his ch 60 miles north of Colorado City. Not one of these died. The re- ining 2 were taken to his ranch in Falls County, and both died from rn fever.
Magnolia Cattle Company, of Colorado City, Mitchell County, that in the spring of 1884, they had taken 285 bulls from Illinois ir ranch in Mitchell and Howard Counties, and that but 3 of the ne number were lost during the summer.
Ir. J. A. Peacock, of San Angelo, Tom Green County, stated that he shipped 1,000 cattle from his range on the head of the Concho River, Tom Green County, to Pecos Station, and had then driven them on trail up the Pecos River, with 800 cattle that had been shipped from Witt County, Texas. During the drive from Pecos Station to Fort ner, N. Mex., 400 of the Tom Green cattle died of Southern fever, ng infected by the 800 cattle from De Witt County. This occurred June, 1884.
. J. D. Merchant, of Baird, Callahan County, stated that he had n introducing fine cattle from the Eastern States into Callahan nty for a number of years, and that he has never lost less than 33 cent. of all such imported cattle. From 1873 to 1876 he had brought umber of fine cattle into Denton County, and that there he lost about per cent. of them.
Ir. J. W. Snyder, of Cheyenne, Wyo., purchased 350 cattle in the ing of 1884 from Gonzales County, Texas, which were shipped di- t from Luling on the Sunset route to Wyoming. They infected a d of 450 Wyoming cattle, from which 80 died. Mr. Snyder believes t cattle might be driven from any part of Texas to Wyoming with fect safety to Wyoming cattle, but that they cannot be shipped by from the infected portions of the State without causing infection.
Glascoe, of Fort Worth, said that he had a ranch 130 miles west ichita Falls, in King County, on which were 1,000 cattle. The nt through a portion of his ranch over which cattle from South- as were driven, and his own herd was infected from this trail, g the death of 40 animals.
J. E. Stevens, of Thurston, Pecos County, stated that he had a miles north of Thurston, on which he placed 140 cattle from

Fayette County, Missouri, in December, 1883. Southern fever developed among these animals from February to May, 1884, and 80 of died. Mr. Stevens stated that these cattle certainly died from Southern fever, and that from a third to a half of all northern cattle taken to his ranch in this county are sure to die.

The Matador Cattle Company, of Colorado City, stated that in 1880, 400 half-breeds were driven from their ranch in Motley ... tle Counties to Gainesville and there shipped North. T crossed the Southern trail on their way and 60 of them died fr ... ern fever.

Mr. J. M. Dougherty, of Denton, Denton County, bought 22 ... cattle from Cooper County, in Missouri, in December, 1877, a the summer of 1878 18 of these animals died from Southern fever.

Mr. Charles Goodnight, of Clarendon, Donley County, whose ... located in Armstrong County, stated that about 100 cattle f herd were exposed to a trail over which had passed 1,500 cattle in early summer that had come from near Fort Mason, Mason County, Texas. Thirty animals out of the 100 died of Southern fever. Mr. Goodnight also stated that in 1878, his native cattle were infected by a herd which came from the country on the Nueces River, west of ... and that 300 animals died as a consequence of this infection.

Brown & McClellan, of Clarendon, Donley County, who ... ranch in Armstrong County adjoining that of Mr. Goodnight, that in 1884 they brought 20 bulls from Emporia, Kans., to their ... that they also brought 500 cows from Tarrant, Kaufman, and ... Counties; that these cows infected their ranch, and as a co ... of the 20 bulls died of Southern fever.

Mr. J. J. Hittson, of Weathersford, Parker County, stated ... 1884, he brought 40 bulls from Missouri to a ranch in Palo Pinto ... that 20 of these contracted Southern fever and died. He ... that Southern cattle do not infect the natives on his ranch in ... and Fisher Counties.

Mr. J. M. Dawson, of San Angelo, Tom Green County, ... 1879 a herd in Motley County was infected by about 9 ... came from San Saba and adjoining counties, and that 500 ... this infection. Mr. Dawson now has a ranch in Tom Green County ... he finds that Southern cattle will infect his native cattle. ... is situated on the Pecos River, 13 miles northeast of Fort ... In the spring of 1884 he took 120 bulls from Missouri to his ... Tom Green County, and that none of these died from Southern ... until some Southern cattle passed through the ranch and ... them.

Mr. Creswell, of Dodge City, Ford County, Kansas, states that ... of 300 cattle in Ochiltree County, Texas, was infected in t ... 1884 by a herd of 1,200 animals from Taylor County, Tex ... passed over the range. A hundred of these cattle died as a con ... of this infection. Another company in the neutral strip l ... of 1,000 cattle by infection from this same herd, which ... lor County. Some of the ranchmen in the Pan-handle s ... believed no Texas cattle would cause infection which came n ... the one hundredth meridian and north of the Texas Pacific ...

Mr. Towers, of Dodge City, Ford County, Kansas, stated that ... of 450 cattle on a range in the neutral strip was infected in ... herd of cattle driven up from Lampasas County, and 100 of ... died from Southern fever.

Mr. H. T. Groome, of Mobeetie, Tex., stated that the ranch occu...

his company was located in Roberts, Gray, Carson, and Hutchinso unties. A portion of the herd was infected by a herd of cattle i 84, driven from near Colorado City, Tex. As a result of this infe n 65 of the cattle died.

Mr. G. A. Brown, of Wichita Falls, had 40 cattle in Donley Count nich were exposed to 200 that came from Williamson County. Twent t se contracted Southern fever and died.

. J. W. Sacra, of Gainesville, Cook County, stated that his ranc located in Donley and Armstrong Counties; that in the summer c 84 he took two herds from the Concho and Colorado Rivers, in To n and Concho Counties, to his ranch, and that they caused no i

He also stated that he took 500 animals in June, 1882, fro nty to his ranch, and no disease was produced by them.

It was stated that Messrs. Gunter & Munson, of Sherman, brough uring the years 1879 to 1882 300 fine bulls from Northern States t rayson County, and that they lost more than half of them from Soutl n fever.

Mr. S. Dyer, of Briscoe County, near Paloduro, lost 100 Hereford ca in 1884 by infection from a herd from Southern Texas.

Mr. W. Dyer, of Hall County, near Paloduro, lost 300 cattle in 18 the same cause.

. W. C. Harris, of San Angelo, Tom Green County, has a ranch 1 west of San Angelo. In the winter of 1883 Mr. Harris brought 3 s to his ranch and these did well until he put a herd from Fri unty upon the same ranch; as a consequence of this they contracte uthern fever and 15 died, but none of the natives raised in Tom Gree unty died from this infection. Mr. Harris and Mr. Peacock both state at it was perfectly safe to bring cattle from the Northern and Easter ates to Tom Green County, provided they were not allowed to com contact with a ranch infected by cattle from the southern part of th ate.

Colonel Young, of Fort Worth, stated that of 100 fine bulls taken to hi nch in Garza County at various times in recent years he has only 1 20 left, and that the majority of these have died from Southern feve

Mr. T. Odham, of Wichita Falls, has a ranch in Gray and Wheele unties. A part of his herd in the summer of 1884 strayed on a tra at was infected by cattle from the country around Fort Worth an st of it. Forty animals died from this infection.

As the information given above was not considered sufficient upo nich to base even a preliminary line locating the extreme boundary e permanently infected district, the following circular was issued i pril, 1885:

DEPARTMENT OF AGRICULTURE,
BUREAU OF ANIMAL INDUSTRY,
Washington, D. C., April 18, 1885.

ortant to Texas cattle-owners:

y attention has recently been directed to the fact that various States and Ter ies have prohibited the introduction of Texas cattle, because of the alleged dang t they will communicate a fatal disease to the native cattle of such States a rritories. Such prohibition is very detrimental to the cattle industry of the wh ate of Texas, and I am informed by the Chief of Bureau of Animal Industry and l ny others acquainted with the subject that the cattle from a considerable part is State do not communicate such disease and are not sources of danger to the catt other States.

Therefore to secure reliable and abundant information as to the limits of that pa Texas from which cattle may be safely taken to other States without restrictions, reby request the cattlemen of the following-named counties to send answers to t

questions hereto appended, directed to the Bureau of Animal Industry, Department of Agriculture, Washington, D. C.

Counties of Archer, Bandera, Baylor, Brown, Callahan, Clay, Coleman, Comanche, Concho, Cooke, Cottle, Crocket, Denton, Eastland, Edwards, Erath, Fisher, Gillespie Greer, Hamilton, Hardeman, Haskell, Hood, Jack, Jones, Kent, Kerr, Kimble, Kinney, King, Knox, Lampasas, Llano, McCulloch, Mason, Maverick, Menard, Mitchell. Montague, Nolan, Palo Pinto, Parker, Pecos, Runnels, San Saba, Scurry, Shackelford. Somervell, Stephens, Stonewall, Tarrant, Taylor, Throckmorton, Tom Green, Uvalde, Wichita, Wilbarger, Wise, Young.

1. Have you purchased any bulls or other cattle, or do you know of any that have been brought from north of the south line of Kansas to your vicinity or to any part of any of the counties named above? If so, state the number, the location as near as possible to which they were taken, and the number, if any, which died of acclimatization fever.

2. Do you know of any cases in which cattle from the eastern counties of Texas have been taken to the counties named above in the spring or summer months and allowed to pasture on the same ranges with the cattle native to those counties? If so, state if any disease occurred among the native cattle, and give symptoms and numbers affected as far as possible.

If the cattlemen of the district referred to unite in sending this information at once it is hoped that it will be possible to secure modifications of the restrictions now placed upon the Texas cattle trade to such an extent as to bring great relief.

Very respectfully,

NORMAN J. COLMAN,
Commissioner of Agriculture.

In reply to this circular the following letters were received:

ARCHER COUNTY.

Mr. E. B. Harrold.—I purchased and brought into this county 42 bulls from De Witt County, Illinois. Three of these animals died.

E. F. & W. S. Ikard.—We purchased 30 bulls in Iowa and brought them into this (Archer) county. One of them died of acclimatization fever.

ARANSAS COUNTY.

Mr. T. B. McCampbell, Rockford.—In the fall of 1878 I shipped from Missouri one car-load of Durham cattle, about 24 head. Lost by acclimation 4 head. Two years ago last fall I brought from Lafayette, Ind., three car-loads (72 head) of Hereford cattle, 40 of which I kept on my own ranch. I lost 2 by acclimation fever, and 2 of bruises received on the journey out. Our cattle are not affected by Eastern or Northern importations so far as my experience leads.

Mr. Thomas M. Coleman, Rockport.—I do not reside in any of the counties mentioned in your circular, "Important to Texas cattlemen," but as you have sent me one I suppose you want information from this section. In reply, I have to say that a greater or less number of cattle have been imported to this section every year since 1874 from north of the southern line of Kansas, mostly from Kentucky, and that about 25 per cent. have died of acclimating fever.

I know of hundreds of instances in which cattle have been brought to this section from Eastern Texas and Louisiana, resulting in no disease to the imported or native cattle.

In addition to your interrogatories I will add that I have known cattle bred and born here, isolated from the range and large pastures, that, when sent out to large pastures, were affected as imported cattle, and as large a per cent. die. Otherwise contagious disease is unknown among our native range cattle.

BANDERA COUNTY.

Messrs. H. H. Carmichael & Co., Bandera.—Messrs. James B. McElroy, of Washington, Washington County, Pennsylvania, Andrew Mansfield and James D. Davenport, of this (Bandera) county, purchased 5 head of fine Durham cattle (2 cows and 3 bulls) in the month of August, 1882, in Washington County, Pennsylvania, and brought them to this place. They were turned out upon the range with our native cattle. All have lived and done well; the cows have brought calves every year since their arrival here; the bulls have served about the same number of cows as are usually served by our Texas bulls.

There are other stock-raisers residing in this county who have fine cattle that were brought from north of Kansas—Judge E. M. Ross and Albert Maverick. They did not

n from the North; they were purchased by them after having been brought o San Antonio. All of the aforementioned cattle have done well on the l have had no symptoms of fever or disease of any kind whatsoever.

BEXAR COUNTY.

ry Terrell, San Antonio.—Referring to your circular of April 18, which ap- he Associated Press dispatches of day before yesterday, I beg respectfully for your information the result of my personal experience of five years of on and dealing in cattle in Texas.
purchased yearly in Ohio and Michigan, blooded cattle, registered herd-book l had the same shipped to my ranch near this city, and have given especial to the so-called "Texas" cattle fever.
ping my fine stock I have had stalls made in the car, had a careful man in rovided barrels of water and an abundance of feed to last through the The stock has not been allowed to be taken from the cars from place of until their arrival in this city. On their arrival here they have been as attended to as possible, no labor or expense being spared to save them. With are I have been able to reduce the loss to less than any other person in the of whose experience I know. My loss has averaged about 20 per cent.
:k imported have an acclimating fever, horses as well as cattle, but the per- f loss in shipping horses from the North is only about 5 per cent.
ortems made on the dead animals (cattle) of my importation show great in the character of the disease. With some the manifold is thoroughly im- ith nearly dry, undigested food. Others show all the indications of death by ia, with a slight adherence of the lungs to the pleura. With others the only of disease is in the spleen and kidneys. One animal, after apparently recov- m the disease, died of gangrene—dry rot, as it were—retaining its appetite ears had fallen off, and when its feet were almost ready to fall off. One, e *post mortem* showed both lungs and spleen affected, seemed to have lost all —arteries and veins free of blood and less than half a pint of coagulated blood art.
nimals were kept in the same stable and sheds with native stock and with saved from previous importations, drank at the same watering place, and r exercise in the same lot. No native or previously acclimated animal has racted disease from such contact with the affected.

o personal interest in the driving of native Texas cattle to Northern markets, ; respectfully to say that your list of counties given should have included, in n, Zavala, Frio, Medina, Atascosa, Karnes, Wilson, Bexar, Kendall, Blanco, Travis, Hays, Comal, Guadalupe, Gonzales, De Witt, Lavaca, Fayette, Cald- . Bastrop. The occasion of all the trouble, in my opinion, arises from ship- le raised on the lowlands of the coast, having very soft hoofs, to such points ta Falls, and then starting them on a dry, hard trail over flint, gravel, and rocks. Such animals become feverish in their feet and legs, and their move- r the trail leaves the germs or poison of a fever on the grass from which the herds are poisoned. I do not believe that our acclimating fever arises from cause.
raised on the dry, hard soil and limestone ridges in the additional counties ould not be quarantined against. This stock is as sound and healthy here e driven North in as good condition, as any other cattle can be. They should assified with the stock raised on the low marsh lands near the coast. And se, if driven slowly from their breeding-ground, instead of shipping to Red rail, can be taken to the Northern ranges without danger of communicating s the long drive before crossing Red River would tend to put them on a footing.
. *J. O. & T. Dawes, San Antonio.*—Our ranch is situated in Wilson, Karnes, scosa Counties. We purchased 3 bulls in the year 1876; shipped them from y and turned them in with our Texas cattle. None of them died from fever; d and did well for several years.
ve handled a great many cattle from different parts of Texas and other States. brought cattle from Louisiana, Mississippi, Mexico, and from the coast of the eastern line, and from several counties northwest, and mixed them with le on our ranch, and have never known of any disease to trouble them. We ver had such a disease as Texas or splenic fever. We have never lost any cept from black-leg or starvation. Our opinion is that the Texas fever is un- n our native Texas cattle, and we do not believe they are capable of impart- ease they do not have.
. *E. Barnard, San Antonio.*—I am not well acquainted with all or any con- portion of the counties named in your circular. I am well acquainted, how- th all Southwest Texas, including with many others, Bandera, Bexar, Frio,

La Salle, Dimmit, Maverick, Zavala, Medina, Uvalde, Kinney, Kerr, Kimble, Llano, Mason, Menard, Crochet, Pecos, Presidio, Tom Green, Concho, Blanco, Hays, and Comal. I have known several parties who have purchased thoroughbred bulls in Kansas, Illinois, Missouri, Kentucky, and Iowa, and shipped them into these counties with varied experience. Sometimes nearly all have died, sometimes none; generally there has been a small loss. The loss in former years has been much larger than of later years. When a loss is sustained now the general opinion is that it is the result of bad management very largely. Our own experience has been that of success; and my own opinion is that with proper care shipments of this kind may be made into any one of the counties I have named with reasonable security.

I have known but three instances in as many years of my own knowledge of the shipment of cattle from eastern counties of Texas into the counties I have named, although no doubt many more have been made. From those within my immediate knowledge no harm was done to native cattle, and great benefit was apparent to the Eastern cattle.

We drove 4,000 from Northern Texas (the extreme northern portion of Texas) to our ranch in Uvalde County, and neither those driven there nor the natives were in anywise injuriously affected.

This section of country which I have named has an altitude of from 700 to 2,000 feet above the level of the sea, and is by me considered the healthiest portion of the United States for both man and beast.

There has not, to my knowledge, been any disease among the cattle in this section during my acquaintance with it, which has extended over about four years. I formerly resided at Saint Joseph, Mo.

Many cattle have been purchased from this section this year for Colorado, and these buyers have nearly all told me that there is no danger from cattle driven over the trail from this section.

There seems to be an almost universal belief that there would be danger from cattle which had been shipped.

I am of the opinion that the counties I have named produce entirely healthy cattle, and quarantine against them is unjust and unnecessary.

Dr. George B. Johnston, San Antonio.—Our secretary has handed me one of your circulars.

"Have you purchased any bulls or other cattle?"

Yes; 16 head of bulls and heifers of T. E. Miller, of Illinois. They were Herefords, and arrived here February 28, 1885. They were shipped in box-cars, and were not unloaded on the way. They began to sicken April 20. Five died from fardlebound or congestion of the manifold. All were sick, some very low. Eleven are now well and quite fat. They were taken to my home farm, 8 miles out from San Antonio.

In answer to your second question I would say that Mark Pruit, of Uvalde County, Texas, drove 400 head of stock cattle from near Houston to his ranch in Uvalde two years ago. I inspected them last spring (to learn how such cattle do here) and found they had no fever, and had given no disease to the native stock.

Cattle grow larger and improve greatly by the change from Eastern to Western Texas. The above stock did so most decidedly. His ranch stock and mine intermingle freely.

BRAZOS COUNTY.

H. B. Stoddard, Bryan.—I have driven and shipped 3,000 to 4,000 head of cattle each year, for the past eight years, from this county to Caldwell, Kans., and Fort Dodge. No complaint ever reached me as to the cattle being diseased, or communicating disease to other cattle.

BURNET COUNTY.

A. R. Johnson, Burnet.—Noticing your published address to the cit
counties in Texas, I take the liberty of answering for Burnet County, [illegible]
not included in your request. We have an elevation of about 1,500 feet [illegible]
level, with a broken and mountainous surface, and numerous streams of pure w
I am confident that it is as healthful for man and beast as any other point in the
States.

In answer to your inquiries I will say that I have a number of Durham c [illegible]
ranch, some of them thoroughbred registered stock, and none of them have [illegible]
any signs of disease. I have driven cattle North myself, and have conversed [illegible]
twenty-five responsible persons who have driven herds from this county No
not one of them have ever known of any disease emanating fr [illegible]
there never has been an instance where complaint has been ma[illegible]

CLAY COUNTY.

Mr. W. S. Ikard, Henrietta.—I would say that I have been buying cattle from Iowa, Illinois, and Missouri for several years. About eight years ago I bought 10 Hereford

from Mr. Miller, Beecher, in Illinois; 7 died, but I think this was caused by ing through. It might have been the result of fever. In 1874 I brought 10 Dur- s from Kentucky; lost none; in 1883 I brought 2 Hereford bulls from Missouri 9 Durhams, and lost none; in 1884, I bought 26 Hereford bulls from Low Hastings, owa, and 2 half Highland Scotch, none of which died during this winter. I don't ave there is any danger here.

COLEMAN COUNTY.

r. R. H. Overall, Coleman.—Referring to your circular of 18th of April, I have to that in January, 1884, I bought of agent of Messrs. A. A. Crane & Co., Henry nty, Illinois, 25 cross-bred Hereford and Durham bulls. They were immediately nsported to my ranch in this county; they arrived about the 20th of the month; e turned into feed-pens with native bulls and other cattle, fed on milled hay and rhum (ar-cane) until the 1st of April, when they were turned loose in pasture with nearly 3,000 head of cattle. Up to the time of turning them t two or three times each day. I am confident I never saw a healthier unch of cattle. Several months after this my hands reported two of lead. On inspecting them one was found to have been gored by a bull; the was so decomposed that I could not make a critical examination of him. These the losses I met with during the season. If any of these cattle were affected h Texas or splenic fever they all recovered, as we found none other than above de- bed dead, and saw none sick.

ve purchased several hundred head of cattle in Arkansas, on parallel with Little and transported them to my ranch for breeding cattle, and have never known f Texas fever among them.

J. O. Cotton, Coleman.—As a cattleman of Coleman County, Texas, I ask leave to your circular of 19th ultimo:

e not brought any bulls or other cattle from north of south line of Kansas, cattlemen of this county have bought such Northern bulls, the number I . I have repeatedly made inquiries of the purchasers of such bulls as to of cl te upon them, and I have never heard of one dying from ac-

brought over 700 head of cattle from near the Gulf coast of Southeast s county in June, 1882. These were pastured along with the native cattle not one of the latter ever died as the result of this contact, so far as I know, disease of any kind occurred to any of the cattle.

nds of cattle are driven through this county annually from Southern western Texas, and I have never heard of any disease resulting therefrom of this county.

orized by my neighbor, Mr. Andrew Young, an extensive cattle-owner of ye experience in this county, to make the foregoing responses to your cir- for him also.

We do not believe that cattle from this section have ever caused disease to Northern le, and we consider the Kansas quarantine a great and unnecessary hardship upon We trust you will be able to grant us relief.

COLLINGSWORTH COUNTY.

J. John Drew, North Elm Creek.—I have during the last nine years been engaged e business of cattle ranching on the open prairie and in inclosed pastures in South- tern Kansas, the Indian Territory (that portion just east of the one hundredth idian and north of the thirty-sixth parallel), and that portion of Texas as indi- d by the heading of this letter, which lies just west of the one hundredth meridian, the thirty-sixth parallel running right through the center of one pasture. This ience, and it is one that has been dearly purchased, has proven to me that there anger from the Spanish fever with cattle coming from that portion of our State, south of the thirty-third parallel. Under no circumstances would I permit any le from a region south of the above line to get near enough, or into, my pasture, t there would be a liability of any of my cattle grazing or watering where they een, until at least after a frost.

buy every year some Southern cattle, but we always hold them out, under close until after first frost.

COOKE COUNTY.

J. G. Witherspoon, Gainesville.—In answer to the first question asked by you in communication through the papers, I will say that we bought and put on our h in Hardeman County 73 Hereford and Shorthorn bulls this spring. We were d to do this from the fact that our neighboring ranchmen, Forsyth Cattle have been buying bulls from the same parties we bought from in the State

of Illinois for two or three years, and they have lost very few, if any, from Texas or acclimatization fever. There have been no cattle turned in our range from Southern or Southwestern Texas, so we cannot answer your second question, but will say that we lost cattle in 1883 from driving on the trail behind Southern cattle, and from contact with them, with the disease known as Texas fever. During last season our neighbors in Cottle County lost cattle in the same way, and for this reason we would be afraid to turn Southern or extreme Southwestern cattle among ours on the range. However, we believe that no cattle raised or held one year north of the Texas Pacific or west of the Houston and Texas Central Railroad are liable to give the disease known as Texas fever to our cattle (in Pan-handle), or to cattle in the State of Kansas, or in any of the Northwestern Territories.

Mr. J. M. Lindsey, Gainesville.—On three occasions I have shipped blooded bulls and heifers from Missouri and Illinois to this county (Cooke) and lost none of them. In the fall of 1882 I brought in from Tennessee 40 head of Shorthorns. I lost 6 of these in the summer of 1883. In the fall of 1883 I brought in 30 head from the same place and lost 8 of them in the summer of 1884. I have known of a great many cattle that were driven and shipped from eastern counties in Texas to Cooke and surrounding counties, or into the Indian Territory. I have known native cattle in these counties affected by reason of these Eastern Texas cattle being grazed and ranged with them.

Mr. S. Witherspoon, Gainesville.—We ranch in Hardeman County. In answer to your first question, I will say that we bought 75 Hereford bulls from Mr. Gregory, of the firm of Gregory, Cooley & Co., of Chicago, live-stock commission firm. The bulls were bred by Mr. G. on his farm near Chicago; were shipped to this county (Cooke) in December, and carried from here to the ranch in April last. None of them have died so far. Our neighbors have been buying blooded bulls from the Eastern States, principally from Illinois, Missouri, Kentucky, and Tennessee, and have had good luck with them. However, I wish to say that I do not believe that acclimatization fever has anything to do with it, or is in any way connected with Texas or splenic fever. Any cattle transferred from one county to another, and more particularly from a northern to a southern county, are liable to die with acclimatization fever, while no cattle were ever known to die of Texas or splenic fever unless they have come in contact with Southern or coast cattle, or have been driven across or on the trail with them. We have never known cattle from our country (Northwest Texas) to give Texas fever. Have never had Southern cattle thrown with ours on the range, but have had cattle to die from contact with Southern herds on the trail. We think the Texas Pacific Railroad a safe line from which cattle can be carried North without danger of imparting fever.

Mr. J. R. Stevens, Gainesville.—No danger of cattle driven from north of Texas Pacific Railroad, and west of Missouri, Kansas and Texas Railroad giving Northern cattle Texas fever.

DONLEY COUNTY.

Mr. James H. Parks, Clarendon.—In reply to your circular letter, I will state that this county is in the Kansas quarantine grounds, which extends in this vicinity to an altitude of about 2,000 feet or higher. Almost all the cattle in this quarantine ground, *i. e.*, bounded on the east by the one hundredth meridian and south by latitude 34, are just like Kansas cattle, subject to the contagion of splenic or Texas fever, and many die from crossing and feeding on the trail used by coast and Middle Texas cattle, just as Kansas cattle do.

I have talked with Mr. Charles Goodnight, one of the best posted cattlemen of the Pan-handle of Texas, and he thinks the cattle native of Andrew, Baylor, Callahan, Cottle, Fisher, Greer, Hardeman, Haskell, Howard, Jones, Kent, King, Knox, Martin, Mitchell, Nolan, Scurry, Shackelford, Stonewall, Throckmorton, Taylor, and Wilbarger will not transmit fever to the cattle in this locality, which is practically the same as Kansas. Mr. Goodnight's herd is Durham and graded Durham. He will not admit cattle to mix with his herd without a thirty days' quarantine of all cattle from a lower altitude than about 1,000 feet above sea-level.

Mr. Goodnight further states that, from practical experience on the trail with cattle that were known to transmit the fever, there is no danger to Colorado or Western Kansas cattle if the coast or Middle Texas cattle are taken on foot through a high altitude, say of 2,000 feet above sea-level, or, in other words, the high altitude of the Pan-handle of Texas will prevent the transmission of the fever during the time it takes to drive about 250 miles.

ERATH COUNTY.

Mr. John A. Frey, Stephenville.—In answer to your communication of April 25, I will say that I have brought and known of being brought to this county 62 head of Shorthorn cattle from north of the line you speak of in your communication. In the year 1867 the Brumington Bros. brought 24 head of cattle from Northwestern Illinois, 17

nd 7 bulls, and in the year 1883 J. M. Bruington, of this county, brought 34 head om the same State, 10 bulls and 24 heifers, and in 1884 G. W. Gentry and myself ought 4 head that were shipped from Kentucky. Out of the lot brought here in 367 by Bruington Bros. 4 died from acclimatization fever. I suppose out of the lot rought by J. M. Bruington (34) three died, not of fever, but I think from black-leg. ut of the 62 head brought here only 4 head have died of the fever.

In answer to the second question, there have been a great many cattle brought to his county from Eastern Texas in all seasons of the year, and such a thing as the attle from that county imparting disease to our cattle here was never heard of, so ar as my knowledge extends.

I forgot to mention, in answer to your first question, that the cattle of J. M. Bruigton, brought here from the North, have been running in the same pasture with ative cattle ever since they have been here, and both the native and Northern cattle re perfectly healthy.

Mr. J. H. Hyman, Stephenville.—In answer to your first question, I will say that I now of about 100 Durham cattle—mixed bulls and heifers—that were introduced nto Erath County, and that only a very few have died, not over 7 per cent. It is ery problematical whether any died except from careless handling and want of proper eed and shelter.

I know of no Eastern Texas cattle being introduced into this county, and have eard of no trouble from this source.

EL PASO COUNTY.

Mr. Louis W. Evans, Camp Rice.—In answer to your first question, I have to say that together with my immediate neighbors, imported from Kansas the 1st of April last ead of Hereford and Shorthorn bulls, and none of them have died so far. Also y friend, Mr. G. T. Newman, whose ranch is located in the eastern part of this ounty, imported from Missouri, some two years ago, a lot of Durham bulls, and lost one.

In answer to the second question, I would say that in May, 1884, I shipped 470 head f cattle from Gonzales County to this place, and drove them from here to my ranch, 5 miles below here, on the Rio Grande, and during the month of July some 50 head r more of the native cattle (with which those shipped had come in contact) died. ly neighbors pronounced it Spanish fever.

Mr. J. C. Beatty, El Paso.—Your circular at hand. The counties named therein are xempt from what is known as Texas fever; but cases have come under my observaion where cattle have been driven from the extreme southern part of the State, and ave transmitted the disease to cattle located on the ranges. So far as my observaion has gone Texas fever is confined to cattle in the extreme southern part of the tate. Bulls brought from north of the south line of Kansas require to be brought in hen young, and if properly taken care of are all right. They are safer in this part f the State than if taken farther east where the elevation is not great.

FRIO COUNTY.

Mr. James Speed, Moore Station.—I will state that I have driven cattle to Kansas ince 1870, and by the commingling of the cattle from Southwest Texas with other nimals they have never taken any diseases from them. I also notice that the county o which I belong is not included in your list.

My brother, S. G. Speed, has shipped cattle from Lebanon, Ky., and has the same attle in Frio County. He lost some on the first shipment, but none on the last shipnt. I cannot see how this is so in regard to Texas cattle breeding disease when no uch thing has ever been discovered in Texas cattle. A great many people in my ounty have become educated to citizenship, and still more of them believe that the General Government should control commerce between the States that belong to the General Government.

GRAYSON COUNTY.

Mr. Joseph Clymer, Sherman.—I have to say that I purchased, in the fall of 1883, 18 head of thoroughbred Shorthorn cattle in Kentucky; transported the same to this county by steamboat and railroad. In the lot I had 13 heifers and 5 bulls; sold 4 bulls and 1 heifer. I still own 12 heifers and 1 bull. All the heifers have been bred and now have calves. None ever showed any symptoms of disease whatever. Our prairie grass has given them a rapid growth.

GONZALES COUNTY.

Mr. J. E. Wilson, Waelder.—In answer to the question asked I would respectfully ay that last year we shipped to Presidio County (which joins Tom Green and Pecos

Counties) cattle from Waelder and from Bee, Live Oak, and Goliad Counties in the spring, summer, and fall of last year (1884), and we have had no disease of any kind whatever up to the present time. The cattle are doing finely and have always been healthy. I also shipped from the counties of Live Oak, Nueces, Bee, and Gonzales to Wichita County some 3,000 head during the months of April, July, August, and October, 1884. I never had one sick nor did they ever affect any of the native cattle there. I have some bulls brought from Ohio to Wichita which have never been sick. One of my neighbors in Presidio County shipped from Ohio some 30 Hereford bulls, which were with our native cattle and have never been sick.

HARRIS COUNTY.

Mr. C. R. Cox, Houston.—In reply to the inclosed request for information, whilst my cattle and the cattle belonging to the members of the Live Stock Association of Southeast Texas are all outside of the counties named in your circular, yet believing information of the fullest character is what you desire, I will give you such information as I can personally vouch for. I have 3 thoroughbred bulls (natives), all well and thrifty, with scarcely any care of feed except what they get on the range.

Mr. L. Winston and Mr. W. I. McNeel, who reside in Matagorda County, each, a number of years ago, bought a thoroughbred Durham bull that did exceedingly well, and lived many years without special care. These bulls were imported from Kansas, while Mr. J. I. Sargent bought at the same time and from the same place several Durhams, all of which died in a few years; all of these parties are neighbors. About three years ago a neighbor of mine moved 1,650 head of cattle from Brazoria County to Crosby County. They have done exceedingly well; have had no disease, nor have they imparted disease of any character to other cattle. Mr. John Duncan bought in Brazoria and Matagorda Counties some 1,200 cattle which he located in Crosby County. They have been very thrifty and healthy ever since, and have not infected other cattle. The cattle of Southern and Southeast Texas have never, as yet, been subject to disease, so far as my knowledge and experience go, and I have been engaged in the business as a specialty for twenty-five years.

Mr. C. C. Gibbs, Houston.—As a representative of southwestern railroad interests I take this occasion to express to you our thanks for the consideration which you have shown to the cattle interests of Texas in the issuance of your recent circular asking questions, which, if properly answered, will enable you to determine officially the non-infected portions of Texas. This is a matter of national importance, for the reason that the tendency of the cattle business is to use our Southern ranges for nursery grounds and the Northern ranges for maturing grounds. It is true that the line as drawn practically proscribes the larger portion of business tributary to our road, but I consider this inexorable, and while for the present it may militate against our interests, in the long run, I hope and think, it may redound to our benefit, believing that in the event of our moving coast cattle to Northern climates, should there be an outbreak of disease, it would simply ostracize business from certain sections for a long time to come. I confidently expect that the railroads having connecting lines from Texas to the Northern ranges will move considerable young cattle every year from Texas. While the movement this year will be necessarily light, owing to the unnecessary restrictions that have been placed by the Northern quarantine officials, we will identify ourselves with the movement, and conduct it in such a satisfactory manner as to lead to its continuance. We realize the fact that this movement can only be made a success by throwing such restrictions around it as will protect Northern native cattle from all possible danger of fever, and we therefore greatly appreciate the position you have taken in the premises. The interests of the railroads are identical with the interests of the cattlemen. We receive in freight on an average about one-fifth of the price of the cattle that are marketed, and therefore the consideration which you have shown for our interests is a recognition we deeply appreciate. It shall be our aim to extend to you our most earnest support in every way possible for the promotion of your interest as well as that of the general public.

JACK COUNTY.

Mr. J. W. Colston, Gertrudes.—My attention has been called to a circular issued by you, asking information regarding the so-called Texas fever within the borders of certain counties enumerated. As secretary of the Young Company Cattle Raisers' Association, I will answer for the counties of Young, Jack, and the southern part of Archer and Clay.

First. There have been numerous importations of blooded stock, including Durhams, Herefords, Polled-Angus, Holstein, and Jerseys to the counties specified by me, and while some showed slight symptoms of acclimatization fever the majority went through without any visible alteration, and, so far as my information reaches, none have died.

Second. There has been no disease, within the bounds specified by me, caused by he introduction of cattle from the western counties of Texas. But there was a very eculiar and fatal disease prevailing last fall and winter, and by well-posted parties t was attributed to the introduction of cattle from Louisiana, Florida, and Mis- ippi.

astly. I think that a careful and unbiased investigation of the so-called Texas or o fever will establish the fact that it is confined principally to the Gulf coast and adjoining counties, and is as prevalent in the other Gulf States as in Texas; and urthermore, that the northern and northwestern part of Texas is as free from the isease as any of the Northern States or Territories.

KINNEY COUNTY.

Messrs. Woodhull Brothers, Spofford.—In reply to your inquiries, we would most espectfully state that we have made some direct purchases and shipments of bulls, eifers, stallions, jacks, horses, and rams from north of the south line of Kansas, and rought them direct here to this ranch for our own purposes and for sale.

(first purchase from the country near Kansas City was in October, 1882, and con- ist... of 3 fine stallions, 3 jacks, and 4 bulls. All of this shipment lived here and remarkably well. The bulls are still alive, except one that got killed on the rail- oad last summer. I saw one of them on the range to-day; he is fat and fine as any ull I ever saw, that ran out loose, in any of Northwestern States.

Our second shipment from the country near about Kansas City was in June, 1883, o ng of 12 stallions and 2 jacks, all of which have done well and given entire n.

...nd shipment from about the same section was in November, 1883, consisting f ..., 18 bulls, and 6 heifers. This stock all did very well, and only one of the ... ...ed, and that was not until a very hot day the following summer; she was ... and died suddenly before we could give her proper care and attention.

...ourth and last shipment from about the same locality was in March, 1884, onsisting of 10 bulls, 3 stallions, and 2 geldings. We never have lost a single horse r jack in any shipment. Of the above 10 bulls some of them became a little sick pon the approach of warm weather, probably produced by the sudden change from cold weather in Missouri to the warm weather here. However, they all recov- d except 2 that died, thus showing that the fall season is the best time to bring ... from the North here. We have also made frequent purchases of fine sheep r ...Vermont and other States, and sustained very light losses in acclimating same. ... have purchased cattle from the central portion of Texas and had them deliv- u here in the spring and summer months. Far from becoming in any manner sick, all began to improve immediately after, and within twelve months from the time arrived here they looked so much better, larger, and like an entirely different

... also have a herd of cattle brought here from Mexico. Not a single one of them as died from fever or any other sickness. We have very frequently seen cattle rom E... ern ond Southeastern Texas, also from Louisiana and Alabama, brought to his se... on of the country, and never saw or heard of a single instance of fever or nvthi... of the kind, but on the contrary, all the cattle seemed to take a fresh start ...ly after arrival here, grow out, and improve wonderfully; even aged cat- ... ...o change, spread out, and grow larger.

... have made a very successful business by buying cattle cheap in Eastern ...xas and Louisiana, bringing them out here to Western Texas for a year or two to atten and grow out, then selling them again at greatly advanced prices. Such a hing as fever or sickness among them, or any other native cattle, is entirely un- nown and unheard of here.

The prohibition, a barrier placed upon Texas cattle this year, has injured our State lions of dollars.

...ast year we sold our yearling steers at $13 here at the ranch; now we are only ...ed $8 for the best ones. Many people who only have common stock are compelled ... sell them for $6 each, in order to procure money to buy the necessaries of life.

KARNES COUNTY.

Mr. W. G. Butler, Helena.—In reply to yours of April 25, I would say that I have rchased several cattle that came from north of the south line of Kansas, and I have st none by acclimatization fever. I don't know of any disease occurring amongst e cattle of the northern counties by Southern Texas cattle being driven and grazed the same range in any month of the year.

LAMPASAS COUNTY.

Mr. W. I. McCausland, Lampasas.—We bought up last April, and turned over to Captain C. C. Howes, of the firm of Miles, Strevell & Howes, of Miles City, Montana Territory, about 2,000 head of young cattle of this county. He carried them through on the trail to their ranch in Montana Territory, and turned them loose with their native cattle, and all have done well—so they report.

Also, last May, I started from here with 2,500 head of cattle, cows, yearlings and two-years old, on rail to Valentine, Nebr., at which point (Valentine) I threw into the Texas herd 400 head of cattle, raised just north of and shipped from Memphis, Tenn., many of which were Durham cattle. We drove the whole herd of 2,900 head through from Valentine, Nebr., to Miles City, Mont., a drive of 500 miles, in May, June, and July, being sixty-five days on the trail. On the 28th of July I turned them over to Henry Tesler and to Frank Westervelt, of Miles City. There were no sick cattle from any cause from beginning to end. Tesler writes me they have done exceedingly well.

Also, our herds got mixed somewhat, in Nebraska, with Missouri herds, and were together during the sixty-five days' drive. The Missouri cattle were from north of the Missouri River. No sickness resulted from the mingling of the herds, as all my men will testify. I lost some cattle on the cars, but it was from trampling, &c.

Messrs. H. T. Hill, J. P. Higgins, W. R. Williamson, and *W. I. McCausland, Lampasas.*—In the fall of 1874 and 1875, Mr. Thomas Sparks, of Lampasas, brought to this county 44 head of Durham cattle from Colorado, and distributed them as follows: To John Townsen, Wat. Smith, Tifford Bean, Henry Hill, and to others, and many of the issue of these cattle are scattered through this and adjoining counties. Of these cattle a few were cows and the balance yearlings. These all lived except 9 head, which died a short time after reaching the State. Some were sick when they reached this county, and nearly all that died were grown cattle. They held their heads down, their ears drooped, had high fever, breathed rapidly, urine highly colored, and their bowels constipated. They seemed to want to keep their heads in the shade. Death followed in a week or ten days. They were shipped by rail, and were exposed to the sun, which was quite hot; the young stock did not suffer as much as the grown cattle. The sickness may have come from the great change of climate, the want of sufficient water, and the discomforts incident to rail transportation.

Mr. Henry Hill, of Lampasas, has been driving large herds of cattle from this and adjoining counties since 1871, and distributing them through Kansas, Colorado, and Wyoming Territory, turning them out with native and other cattle of these countries, and he has never known, during that time, any bad results to follow. Mr. Hill has sold to the following parties: Batey Bros., Denver, Colo.; Sanford Cattle Company, Plattville, Colo.; Van Buskirk, Catlin, Colo., and to others.

Mr. Thomas Sparks, above referred to, has large cattle interests in the northwest, and has driven through, on the trail, with like results. Mr. J. Pink. Higgins and John Townsen, both of Lampasas, say the same thing, to wit: "That the cattle carried northwest by them from this county have never, to their knowledge, carried with them any infectious disease."

Mr. Lee A. Masty, then of Lampasas, but now of Kansas City, Mo., in 1880, brought 30 or 40 head of young Durham cattle to this county from Dallas, Tex. These cattle had all been recently shipped from Kentucky. They nearly all lived and did well. Indeed, we do not know of any loss.

Mr. William Williamson, of the firm of Brown & Williamson, of Lampasas, an extensive stockman, says he has known cattle to be brought from the western, southern, eastern, and northern counties of the State to this county, and that they did well, showing no evidence of receiving or communicating any sickness. And also, that cattle, especially those from the east and south, on account of better feed, were more thriving and became fatter the farther north they went.

MATAGORDA COUNTY.

Mr. A. H. Pierce, Rancho Grande.—I have been as familiar and probably as well acquainted over Texas as any man in it, having imported as many as 80 Northern bulls from Kentucky and Missouri at a time, of which I lost from 33 to 50 per cent. of every lot brought in, and while I live in the coast region of Matagorda and Wharton Counties, will state that Northern bulls die oftener with us than in any of the counties named in your circular, and our cattle driven from Eastern Texas to the counties named do not contract disease at all, and cattle from those counties do not die when brought to us. Every man has his own theory as regards Texas fever. I know there is such a disease, but not to such extent as reported; the cry is raised for self-interest, and it will regulate itself in the next eighteen months. Texas fever is caused beyond a doubt from handling stock badly—late in the season, when the weather is too

water scarce. If they do not have it this season they need not fear it again next five years, as the cattle going North this season are starting later, by 60 ıan usual.

MITCHELL COUNTY.

l. *P. Bush, Colorado.*—I have not bought any bulls from north of the south Kansas, but many have been brought to this section of the country during ıson. McWilliams & King, out of 32 bought in February, have lost one l in the southern part of the county). M. Z. Smisson, in Tom Green County, at of 38, and others have had more or less losses, but as far as my observation 'estigation has gone, bulls brought here at a season of the spring when they fresh and tender grass, have shown lighter losses than when brought during ter. The bulls that have died have, as a rule, not come in contact with nattle. I do not know of any cattle brought from Eastern Texas and turned the counties named in your circular.

I. M. Catlett, Colorado.—In reply to yours of the 25th instant I will say that I ı personal experience in handling Eastern or Southern Texas cattle in the counth and south of Brown County. I purchased a few three-fourths bred Here- Ohio this spring, and have had them on the ranch in Tom Green County for nths. As yet none of them has shown any symptoms of sickness or acclima- fever.

ıot know of a case where Southern or Eastern Texas cattle have given any disrunning on the same range with our native cattle.

I. L. Adams, Colorado.—In reply to your circular of April 25, I will say that ıs been quite a number of bulls brought to the counties named from north of ne of Kansas, and some have died, but in my opinion it was for want of feed an anything else. Cattle driven from the eastern counties into the counties communicate no disease to natives, but graze together and do well. My ranch ed in Borden County.

l. *B. Robertson, Colorado.*—In reply to yours under date of 25th ultimo I have hat I have not only bought Durhams, Herefords, and Polled Angus bulls, and m shipped from even farther north than Kansas, but have been very familiar hers' transactions, and can state without fear of contradiction that in but y instances, the cattle coming from the North have done exceedingly well; in il quite recently there have been no losses in this part of the country of catped from the Northern States, and it is safe to suppose that they did not die s fever.

ıly to your second question, I will simply state that it has been known as an hed fact that the cattle driven from Southern Texas have caused no disease er amongst either cattle in this section or the cattle driven from the South.

NUECES COUNTY.

I. Seligson, Galveston Rancho.—Referring to your circular addressed to cattle in Texas, I beg to state that I have been raising cattle in Texas for thirty-five ıave resided here forty-six years. I know from my own knowledge that six years 1861, when from 30,000 to 60,000 cattle were driven to Kansas each year, we othing of Texas fever. So long as they were driven through we heard very it, but so soon as they were shipped by rail and crowded into cars in hot they became fevered and no doubt in some instances infected others. But deal of this hue and cry of Texas fever is founded on the fact that Kansas and ritories are well stocked with our cattle and they do not wish competition from ıuy longer. They know this to be the great breeding grounds, averaging 90 . of calves as against 60 per cent. with them. Our people in the Pan-handle in who now have their ranges fully stocked, have proclaimed a quarantine against estern Texas cattle. They average about 70 per cent. of calves, so they, lize that they cannot compete as a breeding ground, and they, too, proclaim dependence of law, right, and justice.

:hased 24 bull calves from Smiths & Powell, Syracuse, N. Y., last year, and om acclimatization fever They were twenty-one days on the cars and the was warm.

ıg forty-six years in Texas, I have never known of any disease resulting from riven from any portion of Texas either from East or Southwest Texas, to the ı named in your circular.

PARKER COUNTY.

H. Milliken, Weatherford.—To your circular of April 25, in regard to cat- have to say that about February, 1884, I purchased and brought from

Pleasant Hill, Mo., 38 Hereford yearling bulls, and put them on a ranch on the Brazos River in Parker County. Within the first six months they were all sick, presumably with acclimatization fever, and 14 of them died; the remainder are doing well. J. J. Hittson brought the same number from the same place at the same time and put them in Palo Pinto County. He lost 18 or 20 from same apparent cause.

Eastern Texas cattle are brought into this section every year, and I do not know of any disease occurring among them or among native cattle.

Mr. James P. McFarland, Aledo.—In answer to your questions to the cattlemen of Texas, I would state that I shipped 24 head of Shorthorns (Durham cattle) to Parker County, Texas, from near the line of Kentucky and Tennessee, which is parallel to the south line of Kansas, in November, 1883. Out of that number 16 died of acclimatization fever, leaving 8 alive. All had the fever. The cattle were all fat and in good condition when they sickened and died. All when taken sick refused to eat, and appeared stupid and sluggish. A *post mortem* examination revealed the following facts, viz., lungs in a normal condition, liver highly engorged, and the gall bladder full to repletion, with dark inspissated bile, and presented the appearance as though it had been dipped in saffron. The mucous membranes of the first stomach normal. The second stomach, in every case, was filled with dry, hard food, that required force to pull it asunder. In fact it presented the appearance of an India rubber ball. The kidneys were injected and nodulated; no urine in the bladder. All had, more or less, diarrhea from the time of attack. None of my native cattle on the ranch were affected, though the Shorthorns mixed with them in the same pastures and ranges.

I have no answer to your second question, but I do not think disease is communicated to our cattle from those coming from the West.

PECOS COUNTY.

Mr. W. W. Simonds, Thurst.—In reply to your first question, I will say I know of one bunch of graded bulls coming into our county from Missouri, and about one-half of them died from disease called acclimation fever.

In answer to your second question, I know of no case where cattle have either been sick or have died from any fever of any kind.

REEVES COUNTY.

Mr. A. W. Hilliard, Pecos.—In reply to your circular of April 25, I have this to state: There are several ranches in this vicinity in which young thoroughbreds (Shorthorns) have been imported from Missouri during the last two years. Fifty were owned by J. B. Wilson & Co. Only 3 or 4 died out of this lot by acclimatization fever. Location on Pecos River near New Mexico line.

With an experience of twelve years I have but in one instance known cattle affected by those driven into any of the above-named counties, and that was during the summer of 1878, when a herd of Shorthorns from Colorado were put on the same range with Southern Texas cattle. This was in July of that year.

East Texas cattle have never infected my Shorthorns, and I have handled many in the last ten years.

SHACKELFORD COUNTY.

Mr. W. D. Reynolds, Albany.—I have known quite a number of cases where bulls from Northern States brought here have suffered from acclimation fever, and in cases where they have been turned out to get their own living and be their own doctor the loss has been heavy. When they are cared for and attended to until they pass through the change of fever (which occurs sometimes soon after arrival, and at others six or eight months afterwards) the loss is light, and the cattle seem no more subject to disease than those bred and raised here. S. M. Swenson & Son, of New York, who have a ranch in Jones County, shipped here from Iowa, I think, or some Western State, about 150 head, and I hardly think their losses exceeded 10 per cent. I have known of other cases about like theirs, when the stock has been well cared for. My experience and observation is that all stock from a northern latitude brought south are affected by the change, and even persons claim that they feel the difference. All cattle get sick first or last. Horses for use plainly show that they are not themselves the first year they are brought here. I don't know of a case where cattle were sick and properly cared for in time that it failed to cure them.

Our cattle are graded Hereford and Durham. Some of the males now on our ranch were brought here nine years ago from Illinois, some from Colorado and Kansas. We have several head of cows and bulls raised by T. L. Miller, of Beecher, Ill., which have been here now nine years. We lose quite a number every summer during the heated term, generally good grades, from what is called dry murrain, or Texas fever. The "naw" clogs with dry grasses, the bowels refuse to act, producing fever, from

hich they die. If found in time and attended to we seldom fail to cure them. We ve and ranch on the Forts Griffin and Dodge trail, but can't say whether the cattle hich pass from all parts of the State cause the disease or not, but it seems to be the eneral idea that such is the cause, especially from cattle a good way south and east f here, which, owing to distance, pass during the latter part of June, July, and ugust. We are seldom troubled with it during the spring. I have lived here for hirteen or fourteen years, and before cattle from South and East were driven here nd through here we were never troubled with any kind of disease. Cattle off the oute, and which do not come in contact with Eastern and Southern cattle, seem to e unaffected. I believe cattle from north of here brought in and isolated would have o pass through an acclimation within twelve months. Generally the first three nonths is the time most of them are affected.

TARRANT COUNTY.

Mr. S. W. Lomax, Fort Worth.—Replying to your inquiry of the 25th ultimo, I beg o answer that this company ranches in the counties of Kent, Dickens, Garza, and Crosby. We have for two seasons past bought Shorthorn and Hereford grade bulls, which were dropped in Kansas, and driven to our ranch in April and May, aged yearings and twos. We have lost but very few of them, and those that have died (not over 2 per cent.) have died from nothing of the nature of Texas fever. We bought n the first year 200, and afterwards 500, and cannot state that any died of acclimatiation fever. The few that died seemed affected by ordinary causes.

I do know of deaths being caused to our cattle on the range from contact with Southrn Texas cattle which had been driven through, and I also know of our cattle dying rom what is called Texas fever from being exposed to the trail of cattle from Southrn Texas. Our cattle so dying would be affected noticeably after about nine days rom exposure; they would gaunt up, show signs of high fever, heads down, eyes glassy, and in some instances become very wild and inclined to fight.

On being cut open after death I have found the bowels dry and the intestines hriveled and hard, and the contents very hard and congested.

Your efforts to have a true fever line determined should meet the hearty co-operaion of every Northwest cattle owner, since we suffer greatly under a quarantine deigned to prevent what we could not communicate, and of which we are just as much fraid -- any cattleman in Kansas or Colorado.

H. Somerville, Fort Worth.—Referring to your circular addressed to Texas we have pleasure in replying as follows:

n 1883, and again in 1884, this company (the Matador Land and Cattle Company) urchased in Kansas between 300 and 400 head each year of bulls—Durham and Hereord—from three-fourths grade to pure blood, pedigree stock. In both cases these ere driven from Kansas through the Pan-handle during the month of May, and were rned out on the company's range (embracing portions of Motley, Cottle, Dickens, nd Floyd Counties) between the 1st and 15th of June. We have naturally watched heir progress carefully, and have never yet known one to be sick or diseased; indeed, o the best of our knowledge all, with the exception of three that were killed by acnts, are now alive and in good condition. We are repeating the same practice year with 350 head, being satisfied of its safety.

e are unable to give any information on the subject of your second inquiry.

THROCKMORTON COUNTY.

Mr. B. F. Reynolds.—I drove 200 head of improved cattle from Colorado to this country. They commenced to die at the Canadian River, which is about the thirtyfth parallel, and they continued to get sick and die for eighteen months after leaving Colorado. I lost about 50 or 60 head. I also lost some of the calves that were dropped in the country. Some of them had the bloody and others the dry murrain. hen cut open the stomachs of some would be full of blood, while others would e dry and hard as a plug of tobacco. I have known of many others being shipped to his country, and they all, to the last motherless calf, have some disease, and a great any of them die. But the disease is not contagious, as it does not affect the natives f this country or the cattle from south of here. Neither do cattle from this country affect the cattle of Colorado, as I have seen herd after herd of Texas cattle turned loose among the fine Durhams of that country, and I never heard of such a thing as Texas fever or any other disease except poverty in the five years that I lived there (I left there in 1875). But that Southern cattle do not affect cattle along the south line of Kansas in that large grass country I am not prepared to say, but I drove Texas cattle through there one year, and I heard no complaint. My opinion is that at certain seasons of the year cattle will die more or less along in Southern Kansas and the northern part of the Indian Territory, as that seems to be the worst place for the disease. In regard to the disease that affects cattle brought from the North here, it

seems to me that that is a different disease altogether, as you may bring 100 head here and keep them all in separate places, and they will all get sick and not affect the native cattle of this country; so it seems what makes one sick does not make another sick, and they do not communicate it from one to another.

If you can do anything to help us get cattle from this country North you will be a benefactor, and I think no detriment will result to those of any other locality.

TOM GREEN COUNTY.

Mr. E. B. Bronson, president El Paso International Stock Growers' Association.—In reply to your questions I have to say:

(1) That fine cattle from north of the south line of Kansas have been brought by myself and others to the Pecos River, in Tom Green County, Texas, and to my knowledge none have died of acclimatization fever. In fact, our losses in introducing high-grade bulls on that range are practically nothing.

(2) That during the passage through our ranges on the Pecos River, in Tom Green County, last summer, of Southern and Eastern Texas trail herds, we suffered a loss by death of a considerable number of range cattle, the symptoms as nearly as we could determine being identical with those of the so-called Spanish fever. The number so lost, however, I am unable to state.

Mr. Philip C. Lee, San Angelo.—In answer to your first inquiry, I personally know of 50 head of high grade Hereford bulls brought here in the spring of 1883, and turned loose on the range. The loss was 40 per cent. Also 50 head of same grade and class turned loose on the range, December, 1884. So far there is no loss. But these lots were brought from Missouri. This spring has been cool, with plenty of rain, consequently favorable for acclimating.

I have known of several herds of Southern cattle brought here and turned loose on the range in summer; have never known or heard of the native cattle being affected by any disease from contact. Our cattle are free from diseases of all kinds as far as we know.

Mr. M. Z. Smissen, Colorado.—Being fully aware of the just feeling which prompted the issue of your circular of the 25th ultimo, and for which I most sincerely thank you in my own behalf as well as in that of my neighbors, I hasten to answer the questions propounded as accurately as possible.

(1) I have personally imported from Northwest Missouri, in all, 91 bulls within the last three years. The first lot which I brought out in 1882 consisted of 23 head, of which 16 head were Shorthorns and the others Herefords; they were grades. Of this lot 7 Shorthorns died in the winter. Do not know what they died of.

The next lot I brought out were 68 Herefords, shipped in the spring (March 1, 1883). Only 3 of these died; the balance all O. K., and doing well. The cattle were not kept up, but are running around with the other cattle in the pasture.

Mr. John McWilliams imported 30 Herefords from Southeast Missouri, and lost 1 from disease.

Mr. R. R. Wade, 18 miles from here, brought 18 bulls from Ohio, and lost 10 head. The feed gave out on him on account of railroad strike.

Mr. McMoy, of Sawyer, lost 21 out of 55 Durhams and Herefords mixed. The cattle, when he brought them, had been three months in the country, and it is supposed that if they had been fed they would have pulled through.

I bought 100 head of cows in Hill County and turned them loose here among 10,000 others, and experienced no disease. I know of 440 head of steers being brought up from the coast in 1880 and turned loose here without any bad effect. Do not know of any case in which Southern or Eastern cattle have made any havoc here among the native cattle of Tom Green. However, there have been but few Eastern cattle brought here.

Mr. M. B. Pulliam, San Angelo.—In response to yours of April 25, will say that in 1879 I shipped 35 Durham bulls from Kansas to this county, of which 7 died. The balance are doing well. The 7 died from causes unknown to me. I have known of cattle being driven from various southern and eastern counties, and placed on my range together with my native cattle, but never have known of any having died. I do not think they would convey any disease to native cattle.

Mr. Reuben H. Sherwood, San Angelo.—I have just read your letter to Texas cattlemen. I have been in the business of stock raising for over thirteen years. In reply to your questions I will state my own experience. In the month of October, of last year, I bought 5 thoroughbred bulls from a man in Dallas, which he had shipped from Kentucky in December, 1880. I shipped them to Abilene, Taylor County, and though considered acclimated cattle they took fever from standing in a shipping pen into which had been unloaded a few days before a lot of cattle from Southeast Texas. Three of them died, the other 2 I saved by turning into a pasture stocked with Concho River cattle. I don't consider it a safe investment to ship either cattle or horses to this county from the North, as some of almost every lot are sure to die. Horses are as

death by acclimation as cattle. This county, and most of the high upland in West Texas, are as unlike Eastern and Southern Texas as is Kansas. We ery high, dry country, and in winter it becomes quite cold. Zero is not an ou degree of cold. There have been cattle—bulls—shipped to this county h Kansas and Missouri, and I believe they stand the climate better than others.

. *Rochefort Wade, San Angelo.*—In answer to questions addressed to Texas u with regard to importation of cattle, I beg to state I have purchased a car-20 Hereford bulls shipped from Ohio, out of which I have lost 60 per cent. parties have got bulls, both Hereford and Durham, from Kansas and Missouri. ought from these States have not been as liable to Texas or acclimatization if brought from States farther north. I do not know the exact localities from ney came.

v of several lots of cattle brought from the East to this county, and have had self pastured with the range cattle, and no disease has occurred.

TRAVIS COUNTY.

V. S. Carothers, for Dolores Land and Cattle Company, Austin.—In January, purchased at a place 12 miles southwest of Indianola, Warren County, Iowa, g bulls. Two were thoroughbred Herefords, and the balance were out of high urham cows, by thoroughbred Hereford bulls. We had them shipped by rail. ere snowed up near Autumn, Iowa, and were without food or water for forty-urs and over. Several of them had their ears badly frozen. They arrived at anch in Kinney County, Texas, on January 14, 1884, in bad condition from f time in transit and want of proper care while *en route*. We know that two died from the effects of the shipment, they having been badly crippled. The (6 having died) in all probability, died from the effects of the exposure and tment while on the trains. The 36 left are in good condition, doing well, and on the ranch.

nuary, this year, we bought another lot (41 head) of the same class and from e place as the lot above mentioned. They arrived at our ranch in Kinney Texas, on January 17, 1885, in fair condition. Two died shortly after their here. The balance (39 head) are now on the ranch in excellent condition and ell.

so purchased another lot (Durhams, bulls and heifers) from Hume Bros., near on, Ky., in December last year. They arrived at our ranch in Kinney County, bout Christmas day. Eleven died soon after their arrival there. We then got Dr. E. A. Carothers, of San Antonio, Tex., to go out to the ranch and make al examination into the cause of their death, and see what, if anything, could to save the remainder of the herd. After a more thorough examination and ation of the matter, his conclusion was that they were dying from the effects sure, the weather having been for some time very cold and wet—wet winter —and there was no shelter on the ranch for the herd. Dr. Carothers recom-that we house the herd and feed them well for a time, which was immediately Since then we have only lost one, which died on January 26, 1885. The bal-all on the ranch in good condition and doing well.

0 we moved 8,200 cattle from our ranch from Williamson and Milum counties ne from Bee County), Texas, to our ranches in Dimmit, Zavala, and Kinney , Texas, where they have been ever since. This stock and increase numbers 000 head, and there never has been any loss or sickness among them. The attle that were there in 1880, and with which our stock has intermingled lly, have never been sick or had any disease.

UVALDE COUNTY.

. *F. Buzard, Uvalde.*—Thoroughbred and high grade, Shorthorns, and Here-ls have been brought from north of the south line of Kansas into this and g counties for the past three years. In October, 1884, Searight and Caroth-ght about 50 head from Iowa to their ranches in Zavala and Kinney counties, previous year about the same number with no loss from fever. Dr. Johnson several car-loads from Kentucky to his ranch on the Frio River in this county, ve not heard of his having lost any. Mr. O'Neil brought 3 fine thoroughbred rn bulls from Kentucky four years ago, which are yet doing good service on e. Many other cattlemen have brought in good stock with like result.

ands of cattle from Eastern Texas have been driven into this and adjoining during the spring and summer months, and allowed to pasture on the same ith cattle native to these counties without loss to either, all being alike very

the months of June and July, 1882, I drove from North and East Texas, from of Cooke, Denton, Collin, Hunt, Fannin, Lamar, Red River, Delta, Hop-

kins, and adjoining counties, putting them in pasture with cattle native to those counties. I also, at the same time, brought with those cattle about 150 grade Shorthorn bulls that had been bred in some of the above-named counties. Neither natives nor those driven in have ever had any disease.

Mr. A. Moore, Frio Ranch.—Referring to your printed circular of April 25, I beg to answer the questions contained therein, as follows:

(1) I will state that I have not imported any bulls or other cattle from outside this State. I use full-blood, Texas-raised Durhams and Devons, and have never had any losses from acclimatization fever or experience in regard to that disease.

In answer to your second question, I will state that in September, 1880, I purchased in Austin County, Texas, 1,100 head of stock cattle, and during the same month brought them to this ranch and allowed them to pasture on the same range with my native cattle. During the summer of 1881 I also purchased about 600 head of stock cattle in Nacogdoches and Rusk Counties, in Eastern Texas, and allowed these also to pasture with my other cattle. Out of 6,000 head no disease of any kind, to my knowledge, ever appeared amongst them, and the cattle from the counties named began to show immediate signs of improvement from the day they arrived on the range.

VICTORIA COUNTY.

Mr. N. C. Gullett, Victoria.—I am in receipt of your circular letter to "Texas cattle owners," and although not a resident of any of the counties named therein, as a resident of Southwestern Texas, I take the liberty of answering the questions made in your letter.

(1) For a number of years graded cattle have been introduced most successfully in this and surrounding counties from the States of Kentucky, Missouri, and Ohio; and only last year Mr. J. W. Lake, of Newark, Licking County, Ohio, brought down fully 100 head of graded stock from the State of Ohio, and selling in Victoria, Goliad, Bee, and Refugio Counties, sold on time with guarantee against disease and death from disease. And, as he will tell you if you will address him on the subject, his guarantee was without loss to him, as he collected on all animals sold. I have 1 or 2 improved animals I bought from D. M. Wilson, who has been importing fine stock from Missouri for the last seven years.

To inquiry number two, I would state that the cattle from this section and those of the counties named have come in contact almost every year, and have grazed together on the same pastures without either classes being affected in the least; and as evidence of the falsity of the charges to the contrary, I would only cite the fact that at present this section is selling thousands of cattle to the owners of the ranches in the Territory, Pan-handle, and in New Mexico and Colorado, who are moving them north to and across the thirty-fourth line, when they will call them high-bred Northern cattle, and be loudest in raising the cry of quarantine against "Texas fever." As a matter of course, the cattle they are getting from here now, although finer than ever before, are being sold to them very cheap in consequence of this prohibition, to-wit, one-third less than last year, all of which is very detrimental to the industry and has caused heavy loss here.

WILLIAMSON COUNTY.

Messrs. D. H. & J. W. Snyder, Georgetown.—Referring to yours of April 25 we will state that we have been engaged in the cattle business exclusively since [illegible] during that year drove cattle to New Mexico and sold at Fort Union. In [illegible] drove to Kansas; in 1870 to Schuyler, Nebr.; in 1871 to Cheyenne, Wyo. [illegible] drove the same year to Idaho. We have been driving and ranching in Wy[illegible] Colorado ever since. We now own the old Iliff range and cattle on the So[illegible] in Weld County, Colorado, in connection with Mrs. Iliff and Messrs. Brown, [illegible] We also own a large herd in Stonewall County, Texas, and in Mitchell and T[illegible] Counties, Texas. We mention these facts to give you a correct idea of our [illegible] and experience in the cattle business. In 1875 we bought a car-load of [illegible] cattle, shipped from Boone County, Missouri, to this (Williamson) c[illegible] 40 per cent. In 1876 we shipped a car-load of 25 head from Cheyenne [illegible] head. We have had other shipments since from Missouri and Kentucky, l[illegible] to 50 per cent. We have known of several shipments along the line of t[illegible] Pacific Railroad, west of Fort Worth, into the counties of Taylor, Nolan, [illegible] Green, and others, all of which have lost more or less from the same c[illegible] tization fever. We have driven cattle from the coast of Texas, and f[illegible] parts of the State as far north and west as the counties above named t[illegible] in Colorado and Wyoming, Kansas and Nebraska, and have never lost by [illegible] contact with them. We have as fine a bred herd on our ranch in Colorado [illegible] anywhere in that country, and do not consider that we are taking any [illegible] cattle from any part of Texas and turning them loose on our range w[illegible]

ed animals, but at the same time we think there is great risk in shipping cattle di-ct from the coast, or Southern Texas, to any of the Western States or Territories. 'e know of several cases last year where cattle were shipped directly through from outhern Texas, in which they communicated disease to our native cattle, and the ss was heavy, we being among the losers. We do not know of any disease in chang-g cattle from one portion of Texas to another where they have been driven.

WHEELER COUNTY.

Mr. R. M. Allen, Mobeetie.—We turned loose 77 bulls from Illinois, in Mitchell ounty, on the Colorado River, 20 miles south of Colorado City, in 1882, and estimated loss of about one-third by the end of the following year from acclimatization fever. Do not know by personal observation of Eastern Texas cattle turned loose in said unties and effect of same. Beside latitude, the care and attention that animals re-ive on the trail enter into this question, and to fix a line is a most difficult matter. The Texas and Pacific road is as good a line as any other, and to fix this line works r less injustice than not to have any.

COLORADO.

Mr. A. M. Pryor, Pueblo, Colo.—Your communication of April 18 received this orning. In reply I will say that the counties you mention are, in my opinion, free 'Texas fever. I have driven cattle from the counties you mention to Colorado since 67, and I have never seen a case of Texas fever in Colorado until last season, and e cattle that diseased the native cattle here were shipped from Southern Texas. We ove cattle in here last year from Southern Texas, watered them at the same lakes at our best natives watered at, grazed over the same ground, and turned them loose winter together, and not one of our natives died until late in the winter. Of course, e expect to lose a few cattle from natural causes. However, our losses were very ght the past winter. We are having nice rains and snows now, and cattle will soon in fine condition.

MISSOURI.

Mr. John O. Wood, Canton, Mo.—In compliance with your request for information reference to Texas cattle, I would say that I have been engaged in cattle-raising Throckmorton County, Texas, for ten years, and have shipped bull calves to Texas om Missouri at different times; in all, 81 head. Eleven head died, but I found they d not die of Texas fever, but from acclimatization, and not one of those that I kept and fed and cared for died. This takes about 75 days. I have always taken bulls ere late in November or early in December. I have shipped steers twice from Texas Missouri and put them among native cattle early in November, and no sign of dis-se appeared among my natives. One shipment was made from Tarrant and one om Throckmorton County. In 1880 a lot of Rio Grande (Texas) cattle came through y range and infected my cattle with Texas fever and several of them died. Also in 80 I had a lot of beeves driven up to Caldwell, Kans., and several of them took exas fever from Southern cattle that had been driven over the trail. I never feel e least afraid of Northern Texas cattle being put with my natives here in Missouri.

Mr. George H. Goddard, Saint Louis.—In reply to your official inquiry addressed to ttlemen of Texas, I would state that I have over 15,000 head of cattle, located on e Pecos River, in Tom Green County, Texas. Three years ago I purchased 150 ree-quarters Shorthorn bulls from Motley County, Texas, and moved them to my ace in May without loss from acclimation. Two years ago I purchased 15 high-ade Herefords in Kentucky and shipped them to my ranch in April without loss. ebruary, 1884, I purchased from Gentry, of Suabia, Mo., 100 high-grade Shorthorns om seven-eighths to fifteen-sixteenths thoroughbreds, and shipped them to my ranch ithout loss, and last December I saw the most of them in the general "round-up," oking splendid.

WYOMING.

Mr. A. S. Mercer, Cheyenne.—With pleasure I note your remarks in the press dis-tches of this morning about the Texas dead-line, and when our folks properly un-tand this matter, North Texas cattle will be admitted into Northern ranges; but e is a world of educating to be done. To show you what my views on this sub-re I inclose you an editorial from the *Journal* of April 3. I am familiar with the .e Northwest Texas and know whereof I speak:

I s *and Texas.*—The *Texas Live-Stock Journal* seems to think that a large num-as cattle will be admitted into Kansas by the sanitary board after a few n on the border, in company with native cattle put into the herds, to

determine whether there is a fever germ among them. We think that olive branch of peace that is being held out to Texas drovers is deceptive and should not be borne aloft. There is no doubt in our mind as to the fact that all native cattle north of the Upper Cross Timbers in Texas are as free from splenic fever as are those of Colorado and Kansas. But the herds made up in those sections are so frequently mixed with Southern Texas cattle previously brought in that it is very difficult to get a clean bill of health. Experience on the border shows beyond any question that there is no definite time between exposure to and development of fever. Ninety days is as short a time as is absolutely safe. It has been known to develop at any and every period between ten and ninety days. Hence any such test as above mentioned is valueless, except at the end of the ninety days, and the sanitary board is not likely to make any rule that has an uncertain sound among the people who have forced the quarantine measures and to whom the board is responsible.

"The people owning the cattle in the district where the fever is known to germinate have a right to know exactly what to expect, and should not be buoyed up by false or deceptive utterances that might lead them into trouble. If the gentlemen from the coast know their cattle cannot come in under ninety days they will be loth to drive from Wichita Falls or Harold and take the chances of selling their cattle in the autumn at such figures as those who have range and feed may choose to offer. The fact is that all cattle from what may be termed the infected district will be religiously kept out until the law has been fully enforced. The line of infection is the difficult thing to establish, but when once settled it will be a 'sure enough' dead-line.

"The western or northwestern edge of the Upper Cross Timbers may be taken as a *safe* line, so far as the North is concerned. There are a few counties south and east of this that would probably be safe sections to receive cattle from, but the line would be crooked and uncertain. The question can be determined by honest care, and the people of Texas are as much interested in the matter as those of the North. Any county in North Texas where the native cattle take the fever from coming in contact with Southern Texas cattle is a safe country from which to receive native cattle. And the reverse proposition is true. It is a little difficult to get at an exact, or positive, line just as it is difficult to determine the point where two nicely-shaded lines on a picture blend. There is a sort of middle ground in the picture where the colors cannot be distinguished. So there is a neutral strip on this line of infection. But the line as laid down above is on the side of absolute safety. When properly adjusted there will be a safe inlet for all of the steers from North Texas, and that section is really in the same boat with Kansas and Colorado.

"Instead of a misunderstanding and pulling apart, the people of the South and the North want to enter upon a concert of action that will develop all the facts about splenic fever and enable them to shape their action as to bring about trade and market relations to their mutual interests. Self-preservation is the first law of nature, and the Texan is as quick to assert it as the citizen of Kansas or any other country. But a knowledge of all the facts will aid all those in interest."

REPORT OF S. P. CUNNINGHAM.

In order to gain all the additional information that could be obtained at this time, Col. S. P. Cunningham, an employé of the Bureau of Animal Industry, was directed to make a trip across Texas through the section of the country where the boundary line of the infected district is believed to run, and to gather all the known facts bearing on this question. Colonel Cunningham made this trip and submitted the following report:

SIR: I have the honor to submit the following report of my labor and its results, as an employé of the Bureau of Animal Industry, since my appointment to date. This report would have been in your hands sooner had it not been held back in order to secure information that I knew would have great bearing on its value, and when most of this had been collected I was taken with illness, and write now on a bed of fever. I was appointed July 1, 1885, by Hon. Norman J. Colman, Commissioner of Agriculture, and notified that you would furnish me instructions as to the field and scope of my labors. Under date of July 9, 1885, I received the following from you:

"I desire that you should obtain as accurate information as possible in regard to the movement of cattle from Texas during the present summer. We are anxious to locate the Texas fever line across Texas, and want all the definite and reliable information on this subject that can be obtained."

Accompanying this were questions showing the character of information needed. You also instructed me to obtain from the proper State officers at Austin a ... showing the number of cattle in each of the counties of Texas according to ...

. The movement of the cattle from the State to Northern ranges had already
but, owing to a misunderstanding between the occupants of what is termed
ıtral strip (a map of which I sent you some time since), and the owners of the
n the trail, there had occurred a serious blockade near Camp Supply, in the
Territory. I proceeded to this point, going via. Dodge City, Kans. I sent
port of the situation, after seeing a large number of the cattle, their owners,
ıe ranchmen of the strip early in August, and while there arranged to secure
ve secured since a complete list of all the cattle that left Texas this season by
allas trail, as it has been termed. There were 31 herds passed between July 18
ptember 10, 1885, numbering 78,133 head, and all in apparent good health ex-
few, which died from poverty and black-leg. I have the name of every owner,
mber in herd, destination, and the counties in Texas they started from. About
h of August I was notified by the secretary of the Western Kansas Association, of
City, that fever had made its appearance in several herds in the strip near the
trail, chargeable to the trail cattle, so I returned to Dodge City for the pur-
f investigation. On reaching that point I found Dr. Holcombe, State veterina-
Kansas, there, investigating in the Y pasture where the outbreak was claimed
e been greatest. While awaiting his return I was fortunate in meeting the
s and foremen of nearly every ranch on the strip that had been reported to me
ing fever, and they denied the existence of any outbreak. Dr. Holcombe, on
urn, informed me that he, accompanied by Dr. P. Harden, veterinary surgeon,
ent ten days in searching for cases in this pasture and found *one* dead cow,
had been dead over twenty-four hours, yet from autopsy they both determined
d died from fever. Returning to Texas I found letters from the Pan-handle,
ng me of a fever outbreak in Donley County. I started on September 15,
und quite a serious outbreak had occurred among the native and graded cattle
Cowhart & Co. pasture, near Clarendon. I sent you a report at the time. I
ince traced the cause of the outbreak and found it due to cattle shipped from
an and Houston Counties. The epidemic was of short duration, and the per-
e of deaths less than in ordinary seasons, proving more fatal among high
l cattle than native Spanish, yet several deaths occurred among these. The
in this locality I do not think exceed in all 75 head. Messrs. Finch, Nelson &
owe Bros., and Curtis & Atkinson are reported to me as having lost fully 200
this season, the former from the passage of the Kaufman cattle through their
, the two latter from cattle from Grimes and Limestone Counties. While on
rip I arranged to secure a list of all the cattle that had crossed at Doan's store
he Indian Territory going North, and have since received it. From it I find
ive foots up by this route for 1885, 240,354.

ing sent out the circulars from Commissioner Colman in regard to disease and
ation of cattle, I determined, from receiving so few replies, to travel over the
s from Red River to the Rio Grande. As it was not practicable to make this
r public lines of travel, I secured a good team, guide, and hack, and arranged
t October 1. But receiving notice of an outbreak of fever in Wheeler County,
, I shipped my outfit to Harold, Tex., and then crossing at Doan's proceeded to
tie, from which point I reported to you the result of the outbreak. Returning
l River at Doan's, I continued my long journey to the Rio Grande, and send you
ith the result of that trip.

accompanying map, with the marked line (1) is the one from information gath-
n the road that would be above any remote danger of infection. Starting as it
t the northeast corner of Clay County, including that county and Archer, thence
on east line of Throckmorton to the Clear Fork in Shackelford, I was induced
ce this line from the following facts obtained from Messrs. Curtis & Atkinson,
Worsham, Ikard Brothers, Hon. J. N. Simpson, H. C. Bedford, and a number of
gentlemen who are strictly reliable, and who have been ranging in this section
ars. These gentlemen all agree that this line, drawn as it is north of the Cross
ers, is in a high, healthy latitude; that cattle reared there are as free from in-
g fever to the cattle of the Northern States or Territories as the cattle of Kansas
orado; that they are subject to infection from contact with coast cattle, and
hile cattle of improved breeds when brought from colder latitudes are subject
limation fever, the losses are slight, and when properly cared for do not exceed
cent. Then following on this line (1) south as laid out on the map to the Col-
River, my judgment is supported by the report of a committee of the Brazos
olorado Cattlemen's Association, herewith submitted, marked A. After crossing
olorado River and on to Eagle Pass, I have similar testimony of many ranchmen
he safety of the line. Now, I wish to be clearly understood that I do not hold
reach in this line the southern limit where infection begins; the vast extent
ritory to examine, the impossibility in a few months of gaining all desired in-
tion, renders it impossible to absolutely define a line above which all cattle are
imparting this disease and below which all give off the fever. Yet I do un-
gly affirm that this line is as safe and reliable as any parallel of latitude hith-

erto named by State sanitary boards. At the recent national convention in Saint Louis I had a consultation with Western and Southern ranchmen from New Mexico and Colorado, and from Southwest Texas and the Pan-handle, and they suggested the line marked as No. 3 to be safe. This is to start at Laredo and follow the International Railroad to Taylor, in Williamson County, thence via. Missouri Pacific Railway to Fort Worth, then via. Fort Worth and Denver to Bowie in Montague County, thence due north to Red River. A line (No. 2) from Eagle Pass to Red River was held as perhaps a satisfactory temporary line, but Messrs. R. G. Head, J. N. Simpson, and J. W. Little rather favored line No. 3, from Laredo to Colorado River to Austin, thence up said river to line No. 1, at corner of Coleman and Brown Counties, and then north with said line No. 1 to Red River.

I submit these various lines for your consideration and action, and only regret that there is not more complete data to give you on this important subject. The stockmen of Texas and the ranchmen of the North and West have been brought nearer together by the efforts of the Bureau, and I am satisfied that during the next six months I will be able to gather much reliable information in regard to this disease. Investigations so far this season show the cattle found infected with fever received it from cattle that came from east and south of line No. 3.

Indeed, Kaufman, Houston, Grimes, Limestone, and Freestone County herds are the only ones that were proven to me as having caused infection. As soon as statistical data are collected at Austin I shall forward to you.

Very respectfully,

S. P. CUNNINGHAM,
Employé Bureau Animal Industry.

Dr. D. E. SALMON,
Chief of Bureau of Animal Industry.

In connection with this report Colonel Cunningham submitted the following report of a committee appointed by the Brazos and Colorado Cattle Association:

ABILENE, TEX., *November* 10, 1885.

SIR: As you remember, I, in conjunction with two other members of the Brazos and Colorado Association, was appointed a committee to gather up and present to you the facts regarding splenic, Spanish, or so-called Texas fever, as it affected the range or ranch cattle within the boundaries of this association, an association that extends from the Clear Fork of the Brazos River on the north to the southern limits of Coleman and Runnels Counties on the south, from the west line of Eastland County on the east to Martin and Howard Counties on the west, embracing the counties of Stephen, Shackelford, Jones, Fisher, Scurry, Mitchell, Garza, Borden, Martin, Howard, Midland, Nolan, part of Tom Green, Runnels, Taylor, Callahan, and Coleman, and covering a cattle-range belt of some 300 miles east and west, and 200 miles north and south, and on which at present 400,000 range cattle are run. The climate is dry, range mesquite, free from post-oak, water good, altitude averaging over 1,400 feet. Cattle raised here are very healthy and free from giving off any contagious diseases. At times our county has been charged with spreading splenic fever, but this, when traced to its origin, has invariably shown the fever originated in and was propagated by cattle coming from the coast country. Living and ranching near the center of this belt in Jones County for near seven years, running from 5,000 to 10,000 cattle, we have had no trouble, and never had our herd or young cattle from it suspicioned as spreading fever when sold to Northern ranges; and our committee know as well as yourself that the Spanish cattle in this belt, raised on our ranges, are as free from imparting disease of any kind as any cattle on the ranges of Montana, Wyoming, Nebraska, or Dakota. In regard to acclimation of Northern cattle on our ranges, we acknowledge the sudden change from a cold to a sultry climate gives a slight attack of acclimating fever similar in symptoms to splenic fever, yet when cattle from the North—high-grade bulls or full bloods—are brought in in winter and properly cared for the loss is very light, not exceeding 10 per cent. We and our association, as you well know, use high grade Herefords and Shorthorn bulls. Our grade cattle receive and are liable to splenic fever when brought in summer into contact with coast cattle. The above covers as near as we can hurriedly summarize the condition in our ranges. Anxious like yourself to get at the bottom facts of this business, we wish to uphold your hands in making a complete, thorough, and impartial statement of the situation.

Respectfully submitted,

W. J. BRYAN.
Chairman of Committee, for J. W. Nuen and J. J. Hittson.

Hon. S. P. CUNNINGHAM,
Animal Industry Bureau of United States.

The lines referred to by Colonel Cunningham in his report will be ound on the accompanying map, and are numbered to correspond with he numbers used by him.

It will be observed that in the report of Colonel Cunningham, and in hat of the committee of the Brazos and Colorado Association, the statenents in regard to this disease are general and apply to a large district f country without any definite detailed facts in support of them. This lifficulty has been encountered with many reports received from the State of Texas. Different organizations of stockmen and different indiriduals have different ideas as to the location of the infected district in he State, and these are usually presented in general terms as conclusions from their experience in the country referred to. It is evident hat a definite line cannot be traced from such information as this. The opinions of different individuals will vary, and that of the same indiridual, from year to year, according to his experience at the time. The nly way to draw a definite and safe line of demarkation is to consider he definite observations of cattlemen as to the effect of moving cattle rom one given part of the State or of the country to another given point. When a large number of such observations are collected then we have eliable data upon which to found an opinion that cannot but be in ccordance with the facts. Believing this to be true, I have taken nto consideration the definite statements which have been given in ull above, and I have drawn a line from the Red to the Rio Grande Rivers in such a position that I think it may be assumed that all the ountry west and northwest of that line is free from any permanent inection, and the native cattle from it may be safely taken to any part f the country without disseminating the contagion of Southern fever.

I would repeat here what has been said in regard to other States, that ll the country east and southeast of this line must not be considered s permanently infected; undoubtedly there are considerable sections, possibly whole counties, which are free from the contagion of this disease, and from which cattle might be safely taken to Northern States.

The counties most likely to be uninfected, I judge, from information eceived from the leading stockmen of Texas, are Shackelford, Callahan, Taylor, Runnels, Coleman, Concho, McCulloch, San Saba, Mason, Llano, Gillespie, and perhaps others which are of a more or less mountainous character.

The line which is drawn must, therefore, be considered as a preliminary line, based upon such positive information as we have been able o collect, and is subject to revision and change according to investigations which may be made in the future.

In case the National Government attempts to regulate the movement f Texas cattle and makes a distinction between the infected and the ninfected portions of the State, I would strongly recommend that experiments be instituted to determine from what counties east of this preiminary line cattle may be safely taken to uninfected sections of the ountry. The quarantine restrictions of Kansas and other Western States considered all that part of Texas south of the thirty-fourth parallel of latitude as infected and the cattle from all this part of the State as liable to disseminate the disease. These regulations were doubtless based upon the most authentic information that could be obtained at the time, but it seems very certain from the facts given above that such a division of the State does great injustice to many of the western counties, and if the preliminary line which I have indicated should be adopted cattle from a large section of the State would be allowed to go anywhere without restrictions, and this may be safely done, although

under the regulations of the past year they would have been considered infected cattle. The cattle from east of this line might be allowed to go into other States and Territories as usual, provided they are restricted to well-defined trails and are not allowed to go upon the ranges of susceptible cattle until three months have elapsed since they were driven from the infected country. During the winter months there would be no necessity for any restrictions.

To show the number of Texas cattle west of this preliminary line that may be allowed to move anywhere without restrictions, I append the following table, which gives the cattle in those counties assessed for the year 1885, as compiled from the records of the State and certified to by the comptroller:

County.	Number.	County.	Number.
Andrews	402	Hutchinson	31,700
Armstrong	46,414	Jones	36,172
Bailey	700	Kent	53,570
Borden	22,201	King	30,803
Briscoe	None.	Knox	18,[illegible]
Carson	None.	Lamb	6,700
Castro	None.	Lipscomb	26,209
Childress	81,140	Lubbock	6,[illegible]
Cochran	None.	Lynn	None.
Collingsworth	12,554	Martin	2,17[illegible]
Cottle	39,767	Moore	None.
Crosby	59,885	Motley	61,23[illegible]
Dallam	None.	Ochiltree	26,77[illegible]
Dawson	None.	Oldham	70,77[illegible]
Deaf Smith	None.	Parmer	None.
Dickens	106,545	Pecos (two-thirds)	28,[illegible]
Donley	40,446	Potter	44,[illegible]
El Paso	24,916	Presidio	73,[illegible]
Fisher	59,202	Randall	14,[illegible]
Floyd	19,600	Roberts	22[illegible]
Gaines	725	Scurry	44,[illegible]
Garza	36,150	Sherman	7[illegible]
Gray	3,275	Stonewall	30,50[illegible]
Hale	6,002	Swisher	None.
Hall	15,874	Terry	None.
Hansford	2,550	Tom Green (one-half)	14[illegible]
Hardeman	46,141	Wheeler	17,[illegible]
Hartley	None.	Wilbarger	12,[illegible]
Haskell	7,094	Yoakum	None.
Hemphill	24,709		
Hockley	None.	Total	1,58[illegible]
Howard	24,066		

As the total number of cattle assessed in Texas for the year 1885 was 6,939,901, it will be seen that nearly one-fourth of these are in the district west of the preliminary line referred to above.

THE GAPE DISEASE OF FOWLS.

In the first annual report of this Bureau a complete translation was given of M. Megnin's paper on the *syngamus trachealis* and the disease which it causes. After the publication of that report Dr. H. D. Walker, of Franklinville, N. Y., called our attention to the fact that he had been making some investigations of this subject which had led him to conclusions that would very greatly modify the generally accepted views as to the manner in which the parasite gains access to the body of the host, and also in regard to measures of prevention. To obtain additional light upon this important question Dr. Walker was employed to repeat his experiments, to furnish material with which control experiments might be made in the laboratory of this Bureau, and to sup-

Carroll
Boone
Marion
Baxter
Fulton
Randolph
Clay
Isard
Sharp
Greene
Madison
Newton
Searcy
Stone
Craighead
Minnesota
Pope
Van Buren
Pointsell
Logan
Conway
White
Cross
Yell
Perry
Woodruff
St Francis
Pulaski
Lonoke
Lee
Montgomery
Garland
Saline
Prairie
Phillips
Hot Spring
Grant
Jefferson
Arkansas
Howard
Pike
Clark
Dallas
Dorsey
Lincoln
Desha
Nevada
Ouachita
Calhoun
Drew
Bradley
Miller
Lafayette
Columbia
Union
Ashley
Chicot
Saline
Jasper
Newton
Orange
Jefferson
UTHERN CATTLE FEVER
Line indicated by present information
Line No 1
Line No 2
Line No 3
suggested by Cunningham
Line established by Kansas Law.

ete set of his microscopical preparations for study. We pace to give the more important parts of this work. Dr. eving that the embryo of this parasite has an intermediate invertebrate, living on the infected grounds, came to the nat the earth-worm must be the animal in question. His are quoted in the following pages:

—On September 29, 1883, at 8.30 a. m., a chick about one week old was orms from the bare spot of ground by the side of the coop where the gapes. The worms were carefully washed in water to remove all the o them, which might contain the eggs or embryos of *syngamus*. On 30 a. m., six days and twenty-three hours after the feeding, I observed oms of the gapes. On October 7, at 10.30 a. m., eight days and two ling the chick, and twenty-seven hours after the first symptoms of the l it and found twenty-six gape-worms.

—On October 9, at 8 a. m., another chick a little over two weeks old, was vorms from the same place, with like precautions. At the same time of h, it was fed six worms. On the 11th, 12th, 13th, 14th and 15th, it was laily. At the same time from the first feeding, a little less than seven gapes. It was killed in eight days, and twelve gape-worms found, all

—Commencing on November 13, three chicks, two days old, were fed om my garden, eight, nine, and ten days, respectively. No symptoms ere produced, but to determine positively, the one fed nine days was gape-worms found. This experiment shows that all earth-worms do embryos of *syngamus*. To confirm this, earth-worms from the same repeatedly examined with the microscope.

—Two mature *syngami* were broken in pieces so as to free the eggs. placed on the surface of a dish filled with dirt, well moistened with wo weeks, some earth-worms were placed in this dish and allowed to ays. Three of these were fed to a chick, which was carefully watched No symptoms of gapes were discovered. Evidently the embryos had cess to the earth-worms in sufficient numbers to produce the disease

and 6.—On December 13, two chicks, four weeks and four days old, x earth-worms, from the infected spot, with the same precautions as 15th, 16th, and 17th, the feeding of six worms was repeated, making each chick. On December 20, about seven days as before, they had oms of the gapes. One was killed and twenty-two *syngami* found. l, eleven days from the feeding, the other was killed and sixteen found. e united and in the trachea. None were found in the lungs, but it is ere there, and want of experience in the search prevented their dis-

8, *and* 9.—On April 21, 1884, fed three chicks two days old, each five same place where the others were obtained. Repeated the feeding 24, 25, 26, and 27. On April 28, about seven days from the first feed- gapes. One was killed and *syngami* found in the trachea, also three er part of the left lung, and one pair in the lower part of the right d to feed the two remaining chicks earth-worms, until May 5, just the first feeding, when one was killed and the lower part of the trachea with *syngami*. One of these measured seventh-eighths of an inch two or three others three-fourths of an inch. They contained fully as did also the excretions of the chick just before it was killed. This embryo of *syngamus* in the earth-worms is developed to maturity in the time it obtains entrance to the chick.

—On July 16 fed a chick ten earth-worms, and repeated the feeding ve days. The gapes observed on the seventh day as usual. On July n the first feeding, I killed this chick and found a large number of rachea, and also the embryos in different stages of growth in the

—In order to see if Dr. Megnin's theory was correct, that the eggs within the fowl, I fed a chick, about three weeks old, on July 29, three containing many thousands of eggs. This chick was carefully watched nd no symptoms of gapes observed.

—Three young robins (*Turdus migratorious*) in the nest, fed several worms each daily for twelve days. These earth-worms were taken lace as those fed the chicks. No well-marked symptoms of the gapes Two of them were killed and three or four gape-worms found in the A number were also found in process of development in the lungs.

These birds live almost entirely on earth-worms during a part of the year, and I wished to know whether they would serve as a host for the parasite, and thus be instrumental in spreading the disease. The trachea of robins differs from that of poultry in its size and anatomical structure, especially at its lower part, where the last ring dilates and forms a second larynx. *Syngami* generally collect from the lower part of the trachea to its middle, and the gapes is simply the effort of the bird to obtain more air through this passage, which is obstructed by these worms. It is evident, therefore, that birds which have a larger trachea would harbor a greater number of *syngami* without suffering from the gapes. We see this is the case in chicks after they are several weeks old, for *syngami* can often be seen in their windpipes by opening their mouths and straightening out their necks. Several worms can thus be seen in large chicks with very little embarrassment to respiration. It is also not improbable that although the embryos may penetrate the œsophagus, pass to the lungs, and thence to the trachea, the greater part may be coughed up and swallowed before they are able to obtain a hold on its mucous membrane. We know from an examination of chicks that very many of them are thrown off in this way.

Experiment 14.—On July 4, at 5 p. m., fed a chick about four weeks old a large number of *syngami* just hatched, by turning the water containing them down its throat. On July 11, at 7 p. m., this chick commenced to have the cough or sneeze characteristic of the gapes. July 12 coughs much more. On July 13, at 9 a. m., eight days and sixteen hours after the feeding, I killed the chick and found one single and twenty-nine pairs of *syngami*.

Experiment 15.—On August 14, at 7 p. m., fed a young robin just from the nest a large number of embryo *syngami*, hatched in water, as in the preceding experiment. It was kept in a cage, hanging under a tree, and fed by the old bird. August 22 (morning), robin has some symptoms of the gapes, such as rapid breathing, an occasional gape and shake of the head, and is inclined to sit on its perch instead of standing up as usual. August 23, breathes more rapidly and is evidently quite sick. August 26, continues to grow weaker and breathes more rapidly, and at times gapes, but the gaping is not as prominent a symptom as in the case of chicks. On the morning of the 20th the robin died, the fifteenth day from the feeding. On examination three fair-sized *syngami* were found in the trachea, but not enough to fill it up, so as to produce much gaping.

Earth-worms from infected localities were sent to us by Dr. Walker, in order that we might confirm his results:

May 25.—Three chicks were fed with 8 worms each. One was killed June 4. No evidence of syngames in the entire trachea. Near the pharynx a few blood extravasations on the œsophageal mucous membrane attracted our attention. When carefully examined several small nematode worms were found in the submucous tissue, filled with ova. They were not coiled up but lying in a wavy line. Whether these parasites were introduced with the earth-worms is a matter of conjecture. June 23, the two remaining chicks were set free.

July 1.—Two chicks were fed for two days until one had eaten sixteen, the other eight worms. July 7, two were fed until each had consumed twelve worms. July 24, symptoms pointing to gapes were observed in two of these four chicks. One was killed July 28, and three pairs of adult syngames found in the trachea. The other gaped occasionally, but grew very fast. It was killed August 6, and one pair of large syngames found attached to the trachea.

This pair was torn to pieces on the following day, and the mass, in which were large numbers of eggs, kept in distilled water. On August 17 the embryos could be observed moving about in the shell. Two days later many had left the shell. Thus a period of thirteen days, with an average temperature of 80° F., was sufficient for their development. When placed in distilled water August 6, the stage of segmentation was not yet passed. Megnin mentions twenty-eight to thirty days as the time required for development at a temperature of 68° to 77° F. The temperature of our laboratory ranged from 76° F. during the day to 88° F. at night.

On August 19, three chicks, one three days old, and two over a week old, were fed with these embryos and ripe ova. They were suspended in water and injected down the œsophagus with the aid of a pipette, each bird receiving about fifty individuals.

The younger chicks died on the 1st, 3rd, and 6th of September, respectively. In the last only one pair of syngames was found. Of

two older chicks, one died September 8, without any worms in the chea; the other was killed September 16, no worms found.
Thus our success was only partial, both in feeding earth-worms and bryo of syngames, while Dr. Walker obtained very positive results h both modes of infection.
The foregoing experiments show that earth-worms of infected places contain the embryo. They also show that the earth-worm is not a essary host, and therefore Megnin's views as given in the preceding ort remain still in full force. The embryo is without doubt present the earth-worm for the same reason that particles of earth, leaves, ., are present. The earth-worm in boring into the soil must fre- itly swallow the earth that lies in its way, as pointed out by Dar- n. That ova of syngames should be swallowed in this way is quite ural; and the embryos may even be used as food, and in that case led before they leave the alimentary canal of the earth-worm. So at the question whether earth-worms are really injurious to farmers eating ova or embryos of syngames can hardly be decided in the rmative from these experiments. To Dr. Walker, however, belongs credit of having pointed out the interesting fact that earth-worms infected grounds may produce the disease in chicks which feed upon m.
Dr. Walker examined the alimentary canal of infected earth-worms efully and found therein parasites which he believes were the em- os of *Syngamus trachealis*. We examined a number of worms sent him very carefully, but failed to demonstrate the presence of any bryo smaller than the nematodes, which were quite uniformly present he body cavity and inhabit the segmental organs. These measured out .5^{mm} (.02 inch) in length. Dr. Walker gives the length of the aller embryo as .0118 inch. A certain gregarina (*G. agilis*?) was also quently observed.
Dr. Walker also tried artificial culture of the embryos which he ob- ned from the alimentary canal of the earth-worm. For this purpose used blood serum, into which they were placed and then kept in an ubator. The blood serum was changed every day. Some worms d within two days; others lived for five or six days, during which iod he observed some to molt. The rapidity with which blood serum composes at a high temperature, the toxic effects of the products of refaction, and the poverty in respirable oxygen of this medium make h experiments difficult of execution and uncertain in results.
Dr. Walker suggests that the earth-worms of infected poultry-yards destroyed. To do this the ground is to be covered with lime, salt, ashes, of which substances he prefers the salt.
As to the possibility or desirability of exterminating the earth-worms n poultry-yards where gapes exist among the fowls, the experiments de are neither sufficiently numerous nor so definite in their results as admit of a satisfactory conclusion. That chicks may contract gapes feeding upon earth-worms that contain the embryos of *Syngamus* is nonstrated, but it has also been demonstrated that this is not the only y by which this parasite gains entrance into the body of the chick. destroy earth-worms Dr. Walker recommends saturating the earth poultry-yards with a solution containing 1 or 2 pounds of salt to a lon of water. All interested in this subject should carefully read, in nection with the present remarks, the details of the measures of pre- ion suggested by M. Megnin (First Annual Report of the Bureau an l Industry, pp. 292–295); and in case of failure to arrest the e by these measures, an attempt may be made to destroy the worms according to the recommendations of Dr. Walker.

VERMINOUS BRONCHITIS IN CALVES AND LAMBS, AND ITS TREATMENT BY TRACHEAL INJECTIONS.

The occasional appearance of the disease known as lung-worm disease in cattle and sheep, also called verminous bronchitis, the husk, hoose, parasitic bronchitis, phthisis pulmonalis verminalis, renders it important to put together whatever facts are known at present concerning the nature, cause, and treatment of the disease. The primary seat of the affection being the lungs, the disease might, on superficial examination, be confounded with the far more dangerous disease of pleuro-pneumonia, unless the symptoms and the means of diagnosis during life, as well as the appearance presented by the lungs on *post mortem* examination, be carefully noted. The life history of the parasites that are the cause of the disease is not yet fully known, although upon it depends the most important kind of treatment—that of prevention. The following pages contain the most advanced views, and it is to be hoped that the near future will convert these views into absolute facts upon which a rational prophylaxis may be based. The disease attacking sheep and goats is due to a nematode worm, *Strongylus filaria;* the parasite attacking calves, *Strongylus micrurus*, also found in the horse and ass, is closely related to the former. A third form, common in swine, *Strongylus paradoxus*, does not appear to cause any serious disturbances in swine. In an apparently healthy, fat pig, which was killed at the experimental station last year for another purpose, plugs of these worms were found in the smaller bronchi, enveloped in mucus. In a severe case of swine plague, these same worms were found in the lungs plugging some of the smaller tubes. The lungs themselves were not hepatized, however, as is frequently the case in swine plague, the lesions being limited mainly to the large intestine. Recently this parasite was found by **A. Koch** (*Die Nematoden der Schaflunge*, 1883) to infest in large numbers the bronchi of sheep in an epidemic of verminous bronchitis. The same observer also describes another parasite found in the lungs of sheep, the presence of which was characterized by nodular elevations on the surface of the lungs containing large numbers of hair-like worms (*Pseudalius ovis pulmonalis*).

The disease depends, according to most authorities upon the relative humidity of the soil, and is therefore most prevalent in low-lying, swampy pastures containing pools of stagnant water. Years of abundant rains are said to favor the outbreak of the disease for the same reason. Epizootics have, however, been observed in elevated regions, and in England it is asserted that hill farms suffer most from ravages of *Strongylus filaria*, the lung-worm of sheep. Davaine, eliminating the influence of moisture entirely, states that the only constant features of the disease are age and season. It is probable that outbreaks in elevated regions are exceptional and due to special causes. Young animals, calves from twelve to fifteen months old, and lambs, are most prone to suffer, yet cases have occurred in which adult animals have been attacked. Röll reports the disease in a cow eight years old. It is common during late summer and early autumn, although not limited to this period.

SYMPTOMS.

The disease symptoms are much alike in lambs and calves, both being due to mechanical obstruction of the smaller air-passages. They begin to appear in lambs and yearlings, when driven to pasture in spring and

in the form of a severe bronchial catarrh. There is difficulty in thing and a severe gasping, spasmodic cough. The cough gener- comes on when the herd is driven to pasture. During the parox- s, masses of mucus are occasionally discharged, with great effort, :h contain eggs, embryos, and adult forms of the parasite. With ease in the intensity of these symptoms, emaciation goes on in spite ontinued appetite. Anæmia appears characterized by a paleness of :in and mucous membranes, the abdomen becomes enlarged, the come dim; in sheep the wool comes away. Swelling may ap- : under the abdomen, at the joints, and under the jaws. Death from debility finally terminates the gradual loss of vital powers. ietimes the general plugging up of the smaller bronchi may bring ut suffocation during a paroxysm of coughing. The disease in bs, which is apt to be more severe in fall, may disappear in the spring nilder cases. A French observer reports in an outbreak in calves presence of a painful cough, coming on in veritable paroxysms, far e violent than in simple bronchitis, and frequently leading to suffo- on. Respiration is increased in frequency, the conjunctiva in- ed, the head extended on the neck, the mouth opened widely, and the gue protruded to obtain air. The discharges from nose and mouth tain parasites.

he disease may last from two to four months and the prognosis is ally bad. Cases of suspected verminous bronchitis which die within w days after the first appearance of symptoms ought to arouse sus- on and direct attention to a careful examination of the lungs and y generally immediately after death.

he above brief description of symptoms evidently refers to severe s. The intensity of the disease is proportional to the number of sities which have found lodgment in the lungs. In this disease, efore, all grades of severity may be met with and many of the ptoms above enumerated may be entirely absent.

DIAGNOSIS.

n connection with a careful examination of the symptoms it is of im- ance to examine with a lens, or the naked eye if a lens be not at d, the mucus discharged from nose and mouth. The adult worms appear as small, white, interlaced filaments, like shreds of lint or te hair. Placed in tepid water, these often execute vermicular move- its. The adult forms, especially the females crowded with eggs, ear like masses of coarse, white linen thread.

POST MORTEM APPEARANCES.

n an examination of the body of lambs and calves which have suc- bed to the disease there will be found, besides absence of fat, effusion erum into the pericardial, thoracic, and peritoneal cavities, the usual comitant of great debility. The lungs are pale red, often nodular adherent to the chest-wall. In places the lung tissue is solidified sinks in water. The mucous membrane of the bronchi is inflamed thickened in patches; sometimes there are blood extravasations and tions. The bronchi are often enlarged or saccular. The parasites ves are found in the trachea and bronchi, often rolled up into which occupy the recesses or sacs above mentioned, or plug up ly the smaller divisions of the bronchi. In the larger divisions

elevations or swellings are sometimes met with made up of nests of strongyli.

In the case of a cow which had suffered for months, and finally died from suffocation, Anacker, quoted by Zürn (*Die Schmarotzer*, &c., p. 274), describes the lungs as follows:

> Bronchi filled with bundles of worms enveloped in a viscid, bloody mucus. The mucous membrane presented the appearance of a catarrhal inflammation. It was much reddened and studded with hemorrhagic points and patches. Lungs œdematous. Much serum flowed on cutting into them. Some lobules were inflated and slightly inflamed. Most were hepatized or solidified and surrounded by strips of tissue infiltrated with serum, so that they represented small oblong fields in which the alveoli, filled with pus, were recognizable as small gray nodules projecting slightly above the cut surface. The thorax and pericardium contained much serum.

Several calves affected with lung-worms were received at the experimental station October 21. One of them was killed for examination October 26. During its stay at the station there were no marked indications of pulmonary disease, excepting a cough, which slowly decreased in severity. There was no discharge from the nose, no difficulty in breathing. Physical examination revealed local loss of resonance and increased crepitation.

The lungs (Plates III, IV) had a normal appearance with the exception of some irregular patches of a dark-red color, more numerous posteriorly where the pleura was also much clouded. On removing them from the thorax no adhesions could be detected. The posterior half of both lungs, however, was found doughy, not fully collapsed. Large masses of hepatized tissue were wedged in and bounded by normal tissue. The solidified portions were of a deep-red flesh color, with paler points scattered through it, representing the finest bronchioles. This tissue sank immediately when placed in water. There was no hypertrophy of the interlobular connective tissue. On slitting open the smaller bronchi bundles of adult worms were seen, almost filling up the lumen of the tubes. The worms were arranged parallel with one another, a few projecting from the opening of each smaller bronchus into the larger tube. (Plate IV, Fig. 2.) The mucous membrane of these tubes was pale and covered with a very slight amount of mucus.

Portions of the lung were placed in the refrigerator over night and examined on the following day, when the cut ends of the bronchi were found crowded with worms partly extruded. It was thought that the absence of respiration induced an outward migration of the worms and might explain the crowed condition of the larger bronchi. Of all the worms examined the caudal extremity was turned towards the trachea, however.

Scrapings from the mucous membrane of the bronchi and from the cut surface of the hepatized regions contained ova and active embryos. The embryos within the ova moved at intervals, proving that they were nearly prepared to leave the shell. The bronchi containing the parasites were quite uniformly surrounded with hepatized tissue. The bronchi penetrating healthy lobes were found empty.

In the disease of lambs recently minutely described by A. Koch (*loc. cit.*) the surface of the lungs is studded with ten to thirty yellowish nodular elevations varying from the size of a lentil to that of a walnut and elastic to the touch. Smaller nodules about the size of a hemp-seed usually accompany the others, but are situated near the borders of the lungs. On section these nodules are observed to represent modified air-cells filled with a milky fluid, and containing small, hair-like, interlacing, filamentous worms scarcely distinguishable with the naked eye. Under

ıiscroscope large numbers of eggs and living embryos are also l. These nodular elevations have been described by other authors ınnection with various forms of verminous bronchitis, but it now s probable that they are produced by but one kind of parasite *lalius ovis pulmonalis*).

DESCRIPTION OF THE PARASITES.

ıe lung-worm of cattle is described by Schneider (*Monographie der ıtoden*) as follows:

ongylus micrurus, Mehlis.—Male, 35mm (1.4 inches); female, 60mm (2.4 inches) h round, without noticeable papillæ; cuticle smooth; vulva 18mm (.7 inch) from al extremity. Viviparous. Bursa small, round. Posterior rays three notches of tremity of the common trunk. Middle rays single. Anterior rays separate. ıa short and strong, colored deep brown.

number of lung-worms received recently at the laboratory from the were measured and of three of the adult males the dimensions were ', 50mm, and 53mm, respectively. This would make the average th at least 45mm (1.8 inches). Two adult females measured 55mm and ', respectively. The width of the body in both sexes was from .4mm mm (.015 to .02 inch); the ova within the uterus, and containing ma- d embryos, were .08mm long and .05mm wide. (For drawiugs made these specimens, see Plate V, with description.)

ıe *strongyli* removed from the lungs of the calf at the experimental on were found somewhat shorter. Of ten males the average length about 37mm (1.5 inches); ten females averaged about 47mm in length, lmost 2 inches. The embryos of the lungs measured about .3mm in th (about .012 inch) and .018mm (.0007 inch) in thickness. Those bed from ripe ova a day later were of the same dimensions. The were about .05mm (.002 inch) wide and .09mm (.0036 inch) long.* The t worms within the bronchi were kept for at least forty-eight hours ıe refrigerator at a temperature of 50° to 55° F., and very few mani- ed any movements. After a few hours' sojourn in a normal salt so- ın in the incubator at a temperature of 98° to 100° F., most of them bited very active movements. A large number of ripe ova were ed in temperatures of about 50°, 65°, and 75° F., respectively; within ıty-four hours very few of the embryos of the first lot had left the l, while a large number were found hatched and lively in the third

ıe most common lung-worm of sheep is described by the same author ollows:

ongylus filaria, R.—Male 25mm (1 inch). Female 70mm (2.75 inches). Mouth round. rounded, without noticeable papillæ. Cuticle with numerous longitudinal s. Vulva 30mm (1.2 inches) from the caudal extremity. Ovaries symmetrically ted, anteriorly and posteriorly. Uterus filled with free embryos. Bursa long. e dorsal rays, also shallow notches. Ventral rays separated. Spicula short and thick, dark brown. (Plate VI, Figs. 5 and 6.)

ıese two species are very closely related, but are definitely distin- hable by the different situation of the vulva, and the absence of all cular ridges in the former.

œsophagus of *Strongylus filaria* is about 1.5mm (.06 inch) long, with -like enlargement at its junction with intestine into which its bell- l terminal portion projects. The intestine extends as a brownish through the entire body. The vulva shows as two projecting lips.

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discrepancy in length between this and the other lot of ova is explained when ider that the former were measured fresh.

Very characteristic are the two hollow, dark spicula, about .5mm (.02 inch) long; eggs, oval, .1mm (.004 inch) long, .06 mm (.024 inch) broad. Embryos .5mm (.02 inch) long, and .02mm (.0008 inch) in diameter. Tail slender, slightly curved, pointed. The head has a characteristic cupular projection.

The lung-worm, found frequently in pigs without causing much damage, but also in sheep, where it is said to cause at times severe bronchitis, deserves on this account a passing notice. It is briefly described as follows (*loc. cit.*):

Strongylus paradoxus, Mehlis.—Male 20mm (.79 inch). Female 30mm to 35mm (1.2 inches, to 1.28 inch). Mouth surrounded by six lobes. The two lateral ones largest. Vulva near anus projecting, surrounded by a vesicle or bladder-like body, visible to the naked eye. Caudal end of male, at the base of bursa, curved toward the ventral aspect. Bursa with numerous folds; it cannot be spread without tearing, hence no description possible. (Plate VI, Figs. 1 and 2.)

The male is provided with two very long spicula, measuring 2.5mm (.1 inch) outside of the body. They are hollow, tubular, and neatly marked with transverse bands.

The hair-worm (Plate VI, Figs. 3 and 4) which produces the tuber nodules on the surface of the lungs in sheep (*Pseudalius ovis pu* may be briefly described as cylindrical in shape, 20mm to 30mm (.7v w 1.2 inch) long, .05mm to .07mm (.002 inch to .0028 inch) thick, the f being longer than the male. The caudal portion of the body of the male is wound up in close spirals; that of the female is wavy. Mouth corolla-shaped, with four membranous lips. It contains a boring apparatus resembling a fir cone. The caudal end of the male is cleft and provided with two equal, arched, dark-brown spicules. The free end of each is divided into two spines, toothed ventrally. This latter worm may be readily distinguished from the other forms described by its attenuated form, the absence of a distinct bursa and the bifid spicules. *Strongylus paradoxus* is readily singled out by its peculiar bladder-like attachment in the female, and the very long, hooked spicula in the male. The remaining two species (*Strongylus micrurus* and *Strongylus filaria*) are very much alike, but the habitat will serve as a means of distinction, if the microscopical characters cannot be studied.

The complete life history of the various lung-worms is still a er of speculation among helminthologists. A thorough knowledge of mode of life of the embryos and larvæ before their final establi in the trachea of domestic animals would guarantee better ans of prevention.

In regard to the *Strongylus filaria* of sheep, Leuckart describes the embryos discharged with the mucus as quite well characterized by a button-like projection at the cephalic extremity. They remain alive in moist earth for weeks. They may even dry out and still assume their activity on the addition of water. They molt in about two weeks, and die soon after. Lambs fed with molting embryos failed to take the disease. Four sheep fed at different times with bronchial mucus containing numerous embryos, remained well. Leuckart, therefore, concludes that the embryos, after being discharged from the lungs, probably invade some invertebrate, such as insect or snail, and there attain twice their original length before they are capable of becoming matured when taken up by ruminants. He does not share the views of some wh t tain that the disease is communicable directly from one ani l u other. In other words, the contact of the sick with the healthy dangerous.

Most of the authorities of to-day seem to accept this view, and it cer-

ıly has more in its favor than the opposite. A few, especially among French, adhere to the belief of its communicability.

'he life history of these lung-worms may be summarized briefly as ows: The adult sexually mature worms in the trachea and bronchi, ılveoli (*Pseudalius ovis pulmonalis*), produce a large number of ova, ich finally set free living embryos. These are discharged with the cus and probably enter some invertebrate as a mediate host to un- 'go further development. When taken into the stomach of the final ıt, through the food and drinking water, they migrate back to the arynx and thence into the air passages, where they assume the adult m and set up constant irritation leading to bronchitis. Ruminants ,y be more readily affected in this way, because the food is returned the mouth and with it any embryos which are thus at liberty to enter ɜ trachea and bronchi through the larynx.

TREATMENT.

Preventive measures.—The most important phase of treatment is un- ubtedly the adoption of rules for the prevention of the spread of the ıease. These rules will vary according as we believe the disease di- :tly communicable from one animal to another or not. Presumptive idence leans towards the latter view, but it will be safest to remove ɜ sick from the healthy, if that be possible. This will prevent the ntamination of the stables and pastures with the mucous discharges ıt are known to contain the parasites. The latter, if not immediately ngerous, are potentially so, and when their development is completed ɜ places where the embryos have been deposited may become potent rces of evil. In large herds, where strict attention cannot be given preventive measures, destruction of the diseased animals and anni- ation of the lungs and other diseased organs and products by fire or ne chemical agent is without doubt the safest and most profitable ırse in the end.

On contaminated pastures the parasites are probably taken up in spring d early summer. The disease in lambs may be avoided either by eping them in the stables or by giving them plenty of water to drink fore they are driven to pasture, so that they will not be forced to seek ɜ stagnant pools, the usual abode of parasites. Some food may be ven with the water.

It is thought by some that there is much risk in pasturing lambs or lves on old pastures after adult stock, and that it is advisable to keep em on young grasses and on high ground.

Spinola advises, in addition, the use of anthelmintic substances for nbs in spring and early summer which act injuriously on the para- es in the stomach. A favorite formula of his, which has found its ıy into most veterinary works, is the following:

Wormwood and calamus root, each 2 pounds.
Tansy root, burnt bones (animal charcoal?), each 1 pound.
Sulphate of iron, 3 ounces.
ke into a powder and mix with ground oats as a lick, each lamb to receive about half ounce.

Finally, in adopting preventive measures, the destruction of the para- e must be the chief end in view, and while this is being done suscepti- e animals must be kept away from places where the parasites are sup- sed to be. With these two rules constantly in mind the disease may kept in check. All fodder soiled by discharges should be burnt, in- ıles carefully cleaned; pastures should be drained to remove ıant pools; streams of running water should be kept perfectly

REMEDIES ADMINISTERED INTERNALLY.

The above measures have reference to the safety of uninfected animals. The treatment to be resorted to when the existence of verminous bronchitis has been determined, and it is not desirable to destroy the diseased animals, must be directed, first, towards supporting the strength of the animal, and second, towards the destruction of the parasites.

Good nourishing food is therefore always indicated. A recent writer suggests the use of garlic, which Megnin found so efficacious in the treatment of the gapes. (See First Annual Report of the Bureau of Animal Industry, p. 294.) This should be mixed with the food. Medical treatment has been of various kinds. The internal administration of remedies has been much employed, together with the inhalation of volatile, irritant substances, supposed to have a direct toxic action upon the parasites. Lately, the method of injecting liquids into the trachea has been suggested, and veterinarians are very hopeful of its successful application in the future. First, as regards internal remedies, the following mixture seems to enjoy considerable favor among European veterinarians:

	Grams.
Asafœtida	30
Empyreumatic oil of Chabert	60
Mucilage	500

One teaspoonful daily in milk.

The oil of Chabert, however, is not in the market in this country, making the formula useless. Among other remedies, creosote has been given diluted in water, 63 grams (about 2 ounces by weight) being distributed to 100 sheep. Benzine and picrate of potash are among those recommended. Recently a writer (*Recueil de Méd. Vét.*, 1884, p. 26) reports recovery of 150 cases of verminous bronchitis in calves during a period of three years under the following treatment:

Give, according to size, 10 to 15 centi-grams (1.5 to 2.3 grains) of sulphate of strychnia daily in water. This quantity must be divided into three or four doses, as strychnia is very poisonous. In addition to this, from 10 to 15 grams (2½ to 4 drachms) of sulphide of calcium are given in oats or bran.

To attack the parasites directly in the air-passages inhalations and fumigations have been much resorted to.

The affected animals are placed in a closed building and the medicines vaporized by means of heat. This can be accomplished by pouring them upon heated stones or iron. Crude carbolic acid and tar have been employed in this manner. Certain other recommended substances, among them turpentine and ether, which are inflammable, must be used with care, and ordinarily are converted into vapor without the use of heat. Sulphur may be burned in an iron receptacle. In these fumigations care must be taken that they do not prove too irritating to the air-passages. Several fumigations must usually be practiced to be of any benefit. Strebel recommends a mixture of one part of turpentine and thirty parts of ether, to be dropped into the nostrils of the affected animal. Knowing the irritating effects of ether on the mucous membranes, it is questionable whether such treatment would accomplish anything beyond causing severe coughing.

TRACHEAL INJECTIONS.

Probably the most promising medication which is now being tried is the direct injection into the trachea of liquid medicines known to have

ructive action upon the parasites. The medicines thus introduced
ı opportunity of acting upon the parasites directly before they
ıı absorbed by the mucous membrane of the air-passages. There
ı reason to doubt that they may have even a secondary effect after
: ɔsorption if they are naturally thrown off by the mucous mem-
: of the air-passages and the epithelium of the alveoli, which is the
th most volatile substances.

ıe method of tracheal injections was first tried by Gohier in the
y part of the present century, after learning experimentally that
ıiderable quantities of liquid can be introduced into the trachea
ıout producing suffocation. Delafond some years after conducted
e experiments to determine the absorptive power of the air-passages.
found that mucilaginous decoctions, solutions of sugar or honey,
speedily absorbed when injected into the trachea, inducing slight
ptoms of suffocation for one or two hours. He also found that solu-
s of narcotic agents and stimulants manifest their physiological ef-
s very soon after injection, and that oils and oily medicines produce
ngestion of the lungs which is but slowly dissipated, and that even
/ dilute solutions of mineral and vegetable acids produce inflamma-
, with copious secretion of mucus, giving rise to symptoms of as-
xia and even leading to death.

r. Levi, of the University of Pisa, has recently applied this method
he treatment of a number of diseases (*Manuel pratique des injections héales dans le cheval*, 1883). His experiments also tended to show that
mucous membrane absorbs very rapidly and is therefore less apt to
er from the injection of irritating substances than if the absorption
e less rapid. He also determined that the injection of small quanti-
of oily substances is not dangerous, the oil probably being emul-
:d and absorbed. Finally, there is always a slight reduction in the
ıber of respirations, amounting to about three or four per minute,
r the introduction of liquids, even when distilled water only is in-
ed.

Vithout entering into interesting questions concerning the adminis-
ion of medicines in this manner in other diseases which are discussed
engtb in the work mentioned, we find that the author has experi-
ıted on but one case of lung-worms to test the efficacy of the method.
ers, however, have reported cases in which their success justifies a
ıiled account of the method for future application.

he instrument to be used is a simple hypodermic syringe (Plate VI,
. 7), holding from 1 to 2 fluid drachms. The needle of the syringe
ɜt be provided with a removable solid rod or trocar, so as not to
ome plugged when it is pushed through the skin and walls of the
:hea. As the needles are apt to break, a number of them should be
t on hand. After the operation the syringe should be carefully
ıhed in pure water, the piston supplied with a drop of olive oil, and
trocar replaced in the needle.

t is best to disinfect by filling the syringe and needle with a 5 per
t. solution of carbolic acid, or a .1 per cent. solution of mercuric chlo-
:* before washing in pure water. The disinfection, however, is not
olutely necessary in this operation if the syringe and needle be kept
roughly clean. Fill the syringe and place aside. To introduce the
dle, extend the head of the animal so as to fix and make prominent

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*The former is prepared by adding 5 parts by weight of pure carbolic acid to 100 by weight of pure water previously heated; the latter by adding 1 part of the e sublimate (a violent poison) to 1,000 parts of water.

the trachea, which will be felt as a tense elastic tube along the middle line of the neck. The most convenient point for the introduction of the needle is at about the middle of the length of the neck. It must be remembered that some care is to be observed, as the trachea is in relation with some important structures on either side, the jugular vein, the carotid artery, and the pneumogastric nerve. Having fixed the trachea with the left hand, the needle with the trocar is inserted beneath the skin and then an interannular space is sought so as not to pierce a cartilaginous ring. Or the needle may be pushed directly into the trachea without necessarily avoiding a cartilaginous ring. The unimpeded movement of the free end of the needle as if in an empty space is a sure sign that the needle is in its proper place. The trocar is now removed, the syringe screwed upon the needle and the contents very slowly forced out into the trachea. Before the needle is finally withdrawn, Dr. Levi thinks best to wash it out with some pure water so as to remove the injecting fluid. In withdrawing the needle this might accidentally be discharged in the wound made by the needle and set up inflammation, if the substances introduced be irritating. How this washing-out is to be done he does not state. It seems that a small pipette or medicine-dropper filled with water and inserted into the end of the needle would suffice to wash it out, or drawing back the piston of the syringe would leave the needle comparatively empty. The needle might also be washed out by removing the syringe, washing it out, filling with water, and forcing a few drops into the trachea through this needle. This, however, would cause unnecessary delay before the animal is released, and is, therefore, not to be recommended. The simplest method, then, to empty the needle would be to draw back the piston, for the discharge of anything but the purest water into the wound may produce more irritation than the medicinal substances themselves. The animal should be watched for some time, especially after the first operation, to observe how the injection has been borne, and whether any symptoms arise which indicate difficulty of breathing.

If, as has been suggested, a slight incision be made in the skin before introducing the needle, and if a cartilaginous ring be avoided in piercing the trachea, the ordinary needle with beveled extremity (Plate VI, Fig. 7) will be sufficient, and the trocar may be dispensed with. When the needle has entered the trachea, a slight hissing noise due to the entrance and exit of air with each inspiration and expiration indicates that the needle has reached its destination and is not plugged.

The substances to be injected should have distinctly vermicide properties without being at the same time too irritating or poisonous in their effects on the animal. Levi gives two formulæ which he used with success upon a sheep. The worms were discharged in three days and the catarrh cured.

		By weight.
Iodine	parts..	2
Iodide of potash	do...	10
Distilled water	do...	100

Begin with half a drachm of this solution added to half a drachm of water, and increase by half a drachm of the above solution each day up to 5 drachms. Another remedy is the following: Mix equal parts of turpentine and olive oil, and inject from 1 to 4 drachms. In this case the writer probably intended to state that the dose should be increased from 1 to 4 drachms on successive days.

Eloire (*Recueil de Méd. Vét.* 1883, p. 683) gives the following formula:

Ordinary oil of poppy and oil of turpentine, each	parts..	100
Carbolic acid and purified oil of cade, each	do...	2

il of poppy, being a bland oil, does not possess any medicinal es, and may be replaced by olive oil. Each calf to receive drachms a day for three days.

nimals treated in this way showed immediate improvement and ally cured. Penhale (*Veterinarian*, 1885, p. 106) reports imme- lief and ultimate cure in two calves by injecting the following :

rpentine	drachms..	2
acid	drops..	20
m	drachm..	½

on (*loc. cit.*, p. 62) reports favorable results in six out of eight y injecting the above liquid, in which 1 drachm of the tincture of vas used in place of the chloroform.

completes the list of remedies thus far suggested and tried, and ılts obtained therefrom. The favorable testimony, though not nt, is very encouraging. There are many substances, no doubt, of which might be more beneficial than those mentioned, but can be said of them until they have been tried.

is connection a few experiments may be described having for oject the infection of healthy calves with lung-worms and the nation of the effect upon them of intra-tracheal injections.

ctober 30 two calves were fed with a large number of strongyli hundred), obtained from the lungs of the calf described in the ng pages as having been killed at the experimental station in determine the presence or absence of lung-worms. Live em- ere present in large numbers in the worms consumed. Worms, vere kept for a few days at a temperature of 70° to 80° F. in set free ova which hatched within one or two days. The embryos ed alive about five days, the water being occasionally changed. the calves thus fed was reported to cough now and then. This led December 17, over a month and a half after feeding. No or lesions referable to them were found after a careful search n the whole lung tissue. The other calf remained well.

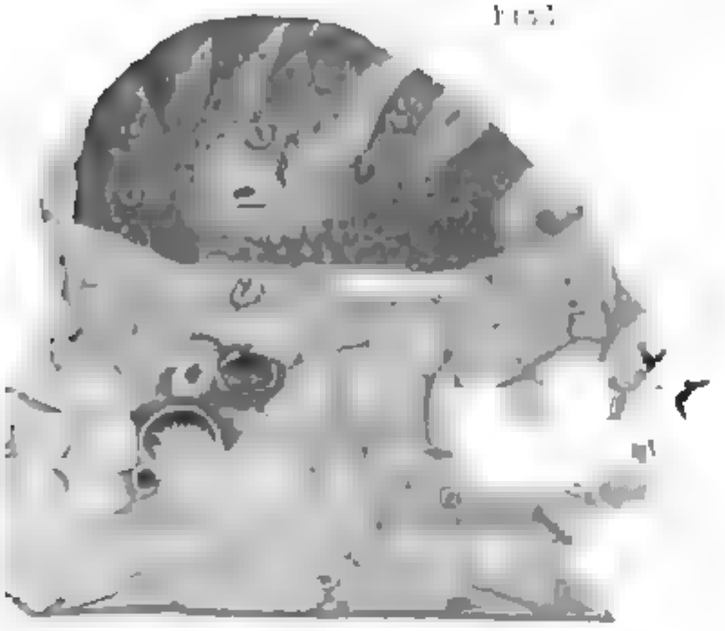
neal injections were tried upon several calves which had been l with verminous bronchitis. The injections were made too late, r, and prove simply that injections may be practiced without ır of untoward results. The worms had probably disappeared the injections were made. The following is a brief résumé of ials :

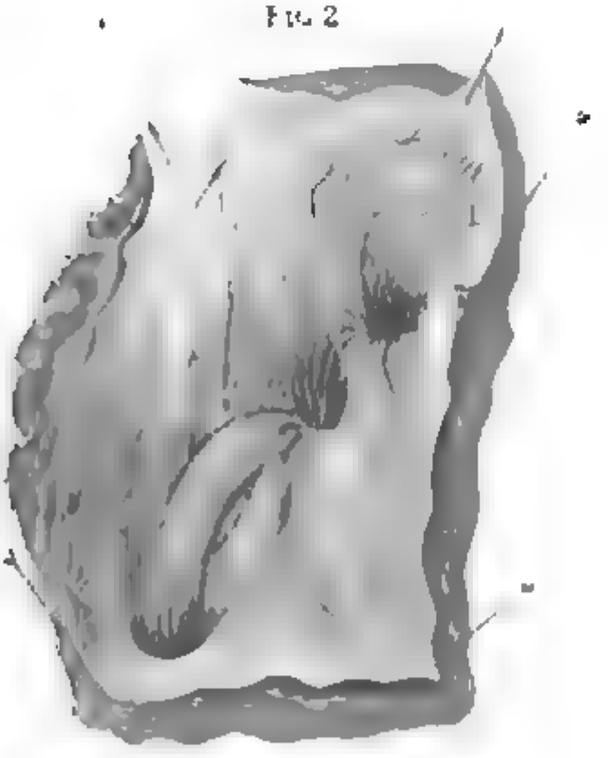
ll calf received from New Jersey, October 21, 1885, was treated ber 18, 1885. The liquid consisted of turpentine 2 drachms, orm half drachm, carbolic acid 20 drops, and was injected ac- to the directions given in the preceding pages. During the on the animal coughed a few times, but was otherwise not incon- ed. No after effects observed. Improvement slight. January ond injection was made. The animal coughed frequently and ed more violently, exhibiting a greater sensitiveness than at the ection. For a few minutes after the operation symptoms refera- næsthesia were observed. The animal was killed January 11. achea was carefully examined, but no inflammatory reaction no- The posterior lobes of the lungs contained hepatized masses ly caused by lung-worms. There was no trace of the latter ex- a few degenerated ova in the mucus of the bronchi. We con- from these facts that the worms themselves had disappeared he last injection.

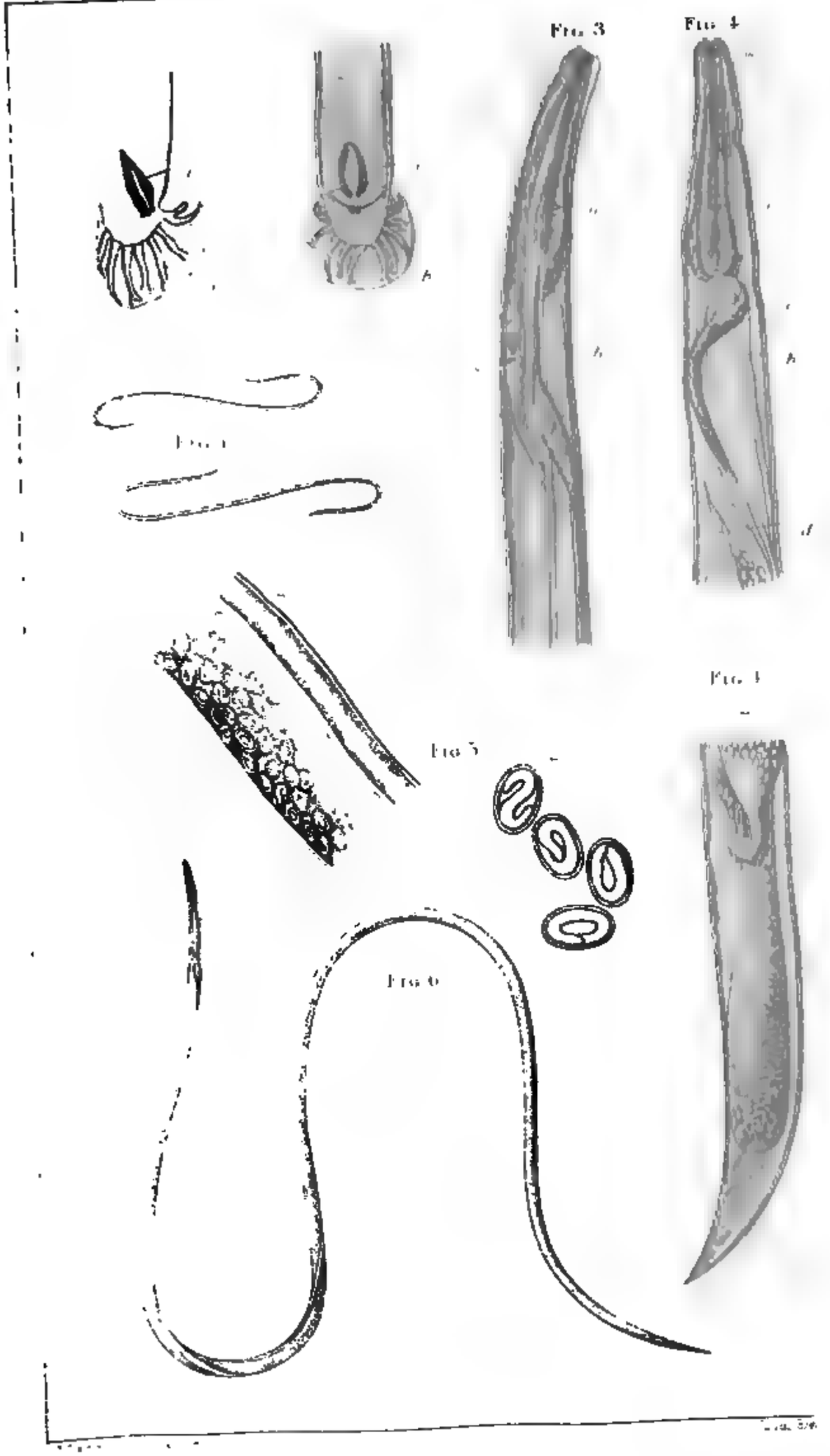
On another calf received at the experimental station October 27, 1885, an injection was practiced as in the first calf, January 6. It was killed January 9. Near the place of puncture in the trachea several small extravasations were observed. No inflammation produced. Regions of hepatization were present in this lung, but no trace of lung-worms could be discovered.

A third calf, presumably affected with lung-worms, which had been at the station since October 21, was treated January 12, 1886, in the same way. For a few moments anæsthesia was very marked. To avoid any doubt as to the presence or absence of lung-worms in this animal, independent of any effects due to the injection, it was killed on the following day. The thorax contained large quantities of chocolate-colored serum. There were a few small extravasations under the mucous membrane of the trachea near the puncture, and a diffuse reddening of the entire tracheal membrane. In both lungs the anterior lobes were completely hepatized and full of serum, which flowed abundantly on section. The bronchi in these lobes were occluded by plugs of very thick, whitish mucus. Other regions of localized hepatization pointed to lung-worms as a cause. These, however, were the result of some severe broncho-pneumonia, probably not due to the injection, for they seemed to be lesions of more advanced age. No lung-worms were present.

In these three animals the lung-worms must have disappeared before the injections were made, and therefore the experiments fail to give any information as the effect of such injections on lung-worms. They confirm the facts already pointed out in in the preceding pages that injections may be borne by the bronchial mucous membrane without producing any marked disturbances.

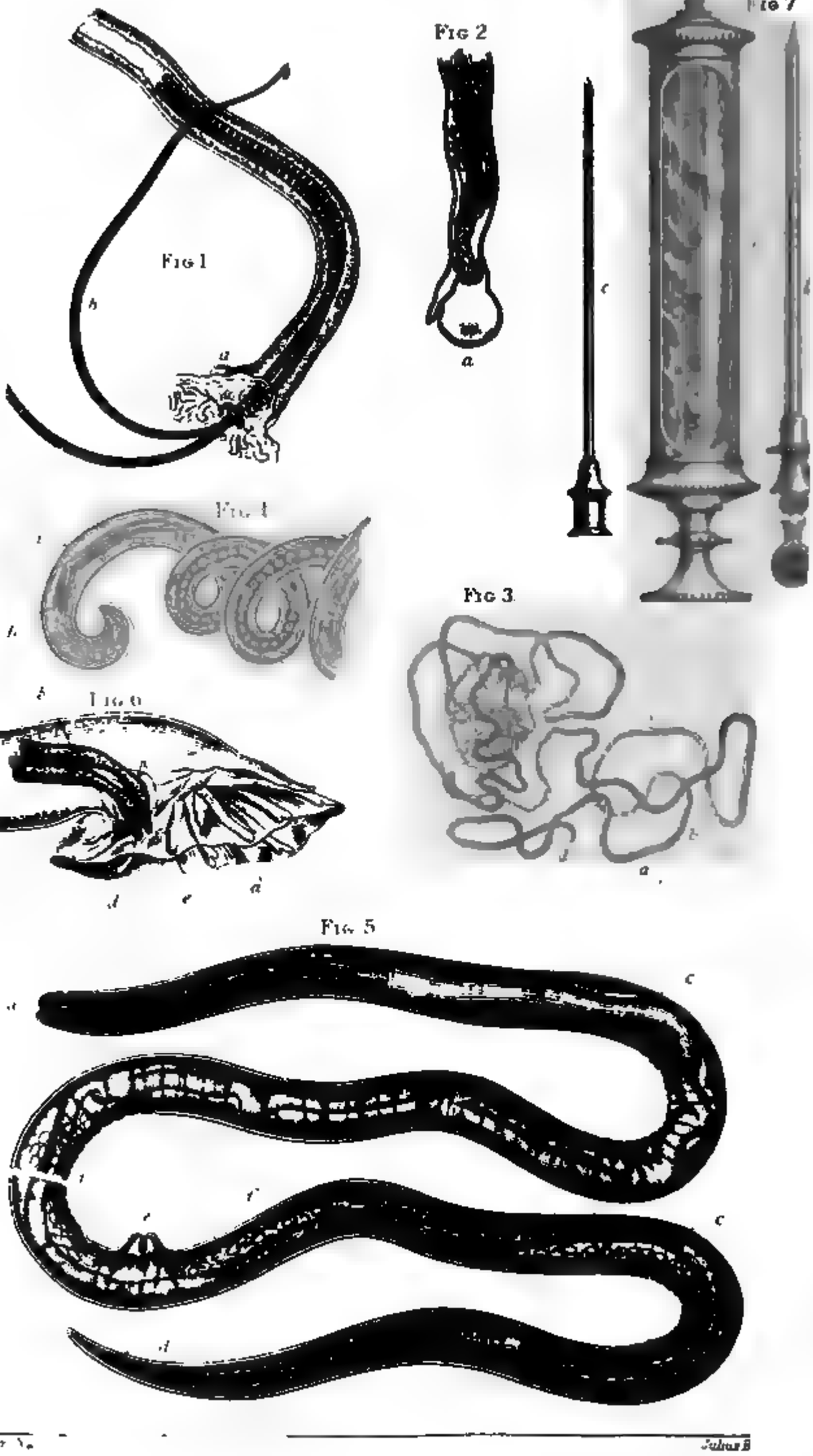






STRONGYLUS MICRURUS

(Verminous Bronchitis)



VERMINOUS BRONCHITIS.

DESCRIPTION OF PLATES.

ɪᴇ III.—Left lung of a calf affected with verminous bronchitis. Lateral aspect. The greater part of the surface has a normal appearance excepting the islands representing hepatized tissue. The pleura over the posterior half is more or less opaque. Clouded (x ⅔).

ɪᴇ IV, FIG. 1.—Trans-section of the left lung represented on preceding plate. A considerable portion of the lung tissue is hepatized. Toward the left a bronchus is seen in section, filled with strongyli (x ⅔).

2.—A large bronchus from the same lung, slit open and showing the openings of three smaller bronchi. Bundles of worms projecting therefrom.

ɪᴇ V, FIG. 1.—*Srongylus micrurus*, about natural size. *A*, male; *B*, female.

2.—Caudal extremity of the male, showing the bursa *b*, supported by twelve rays, from two different aspects, *a* the two short spicula (x 50).

3.—Anterior extremity of the male, showing the mouth and œsophagus *a* leading into the intestine *b*. The two unicellular glands of the neck are shown with their enlargement *c* containing a minute nucleus (x 40.)

4.—*A*, anterior extremity of a female; *a*, *b*, *c*, as in Figure 3; at *d* the oviduct is bent upon itself and continued into the uterus which contains some ova. *B*, posterior extremity showing at *e* the flexure of the oviduct and entrance into uterus filled with ova; *f*, the enlarged posterior portion of the intestine (x 50).

5.—*A*, portion of the body of a female near the middle of the body with ova containing fully developed embryos (x 40). *B*, the ova with the embryos occupying different positions (x 120).

6.—An adult female filled with ova (x 4).

ɪᴇ VI,* FIG. 1.—*Strongylus paradoxus*, caudal extremity of the male showing *a*, the bursa; *b b*, the spicula, hooked at the free extremity.

2.—Caudal extremity of female with pear-shaped vesicle *a*.

3.—*Pseudalius ovis pulmonalis*, female; *a*, *b*, *c*, constrictions; *d*, caudal extremity; *e*, mouth (x 50).

4.—Caudal extremity of the male (x 800); *a*, spicula forked at *b*.

5.—*Strongylus filaria*, female; *a*, mouth; *b*, funnel-shaped insertion of œsophagus into intestine; *c c*, intestine; *d*, caudal extremity; *e*, vulva; *f f*, uterus.

6.—Caudal extremity of male; *a*, bursa; *b*, spicula; *c*, flap-like attachment, and *d*, conical, blunt extremity of the same; *e e*, rays of the bursa.

7.—Syringe used for tracheal injections; *a*, syringe with glass barrel and graduated piston-rod; *b*, hollow needle with trocar; *d*, needle with beveled extremity without trocar.

Figs. 1 to 6, inclusive, are taken from A. Koch's *Die Nematoden der Schaflunge*.

UNITED STATES NEAT CATTLE QUARANTINE.

The superintendents of the various neat cattle quarantine stations report the names of the importers, and the number and breed of each lot of animals imported during the year 1885, as follows:

WALTHAM AND LITTLETON STATIONS, MASS.

DR. J. R. MCLAUGHLIN, SUPERINTENDENT.

Date of arrival.	Name and post-office address of importer.	Port of shipment.	Name of breed	Number of animals.
1885.				
Feb. 16	Thos. B. Wales, jr., Iowa City, Iowa	Liverpool	Holstein	9
Mar. 27	J. J. Hill, Saint Paul, Minn	do	Durham and Angus.	127
Apr. 1	S. F. Perry, Lenox, Mass	London	Holstein	40
May 1	Everett Smith, Waltham, Mass	do	do	13
19	T. B. Wales, jr., Iowa City, Iowa	do	do	30
28	H. W. Hockema, Washington, Minn	Antwerp	do	8
29	F. Codman, Brookline, Mass	Liverpool	Guernsey	6
June 2	T. F. Koch, Chicago, Ill	Amsterdam	Holstein	58
Aug. 26	W. L. Archibald, Oxford, Miss	London	do	190
Sept. 9	James L. Flint, New York City	Glasgow	Polled Angus	3
Oct. 16	William A. Russell, Lawrence, Mass	London	Holstein	82
Nov. 13	James Cunningham & Son, Dalbeattia, Scotland	Glasgow	Galloway	200

GARFIELD STATION, N. J., NEAR NEW YORK.

DR. A. M. FARRINGTON, SUPERINTENDENT.

1885.				
Jan. 2	S. P. Dyt, Passaic, N. J	Antwerp	Holstein	50
19	Hyltje Bakker, West Chester, Pa	do	do	15
26	John A. Desseaux, Isle of Jersey	London	Jersey	20
Mar. 7	Guthrie, Bell & Co., Shelbyville, Ky	do	Holstein	60
Apr. 6	D. H. Archibald, Oxford, Miss	Amsterdam	do	28
May 7	E. Huidekoper, Meadville, Pa	do	do	1
7	J. H. Maginnis, New Orleans, La	London	Jersey	2
7	F. B. Savage, Newburg, N. Y	do	Holstein	10
7	Guthrie, Bell & Co., Shelbyville, Ky	Amsterdam	do	59
7	French Brothers, Cincinnati, Ohio	London	do	82
June 1	Edward Kemp, Fair Haven, N. J	Antwerp	do	11
1	B. B. Lord & Son, Sinclairville, N. Y	do	do	69
4	Hyltje Bakker, West Chester, Pa	do	do	20
4	William A. Singerly, North Wales, Pa	do	do	20
22	Sluiter Brothers, Brooklyn, N. Y	Amsterdam	do	65
July 1	J. L. Gardiner, Springs, N. Y	London	Guernsey	6
1	J. C. Duncan, Normal, Ill	France	Normandie	2
Aug. 14	E. Smith Jameson, Mount Sterling, Ky	London	Red Polled	2
18	A. Oltmans, Ridott, Ill	Hamburg	Ost. Friesian	26
25	James Oliver, South Bend, Ind	Glasgow	Ayrshire	9
31	W. H. Goodpasture, Nashville, Tenn	London	Holstein	50
31	Wm. M. Singerly, North Wales, Pa	do	do	20
Sept. 5	T. S. Cooper, Coopersburg, Pa	do	Jersey	7
5	George V. Forman, Ocean, N. Y	do	do	16
19	S. P. Dyt, Passaic, N. J	do	Holstein	10
19	James F. Sutton, Bedford, N. Y	Amsterdam	do	21
Oct. 5	Hyltje Bakker, West Chester, Pa	Antwerp	do	30
5	J. Kellenberger, Centreville, Va	London	Swiss	5
26	W. H. Johnson, Centre Rutland, Vt	do	Jersey	19
29	A. Sutherland, Denver, Colo	Antwerp	Holstein	26
Nov. 7	Bastian Diebel, Garfield, N. J	Amsterdam	do	20
Dec. 10	J. H. Offord, Topeka, Kans	London	Red Polled	20

COOPERSBURG AND CHESTER STATIONS, PENNSYLVANIA.

DR. FRANCIS BRIDGE, SUPERINTENDENT.

Name and post-office address of importer.	Port of shipment.	Name of breed.	Number of animals.
M. Harkness, Philadelphia, Pa	Liverpool	Jersey	30
S. Cooper, Coopersburg, Pa	Southampton	do	86

PATAPSCO STATION, NEAR BALTIMORE, MD.

DR. A. H. ROSE, SUPERINTENDENT.

R. Tucker & Co., Baltimore, Md	Liverpool	Jersey	40
illiam Miller, Coteau Landing, Canada	do	Hereford, Angus, and Galloway.	60
muel C. Kent, West Grove, Pa	do	Guernsey	42
arles C. Lening, Philadelphia, Pa	Bremen	Holstein	7
ward Paul, Heron Lake, Minn	Liverpool	Galloway	22

SAN FRANCISCO STATION, CALIFORNIA.

DR. A. DE TAVEL, SUPERINTENDENT.

D. Spreckles, San Francisco, Cal	Honolulu	Hereford	41
W. Brown, San Francisco, Cal	do	Polled Angus	24
igh Craig, San Francisco, Cal	Auckland	Hereford	15

number of cattle received at the various stations from January January 1, 1886:

id Littleton Stations	775
tion	827
g and Chester Stations	66
ation	171
sco Station	80
	1,919

g the number of cattle received at the various quarantine stations of the United States for each month of the year.

nth.	Waltham, Mass.	Garfield, N. J.	Chester, Pa.	Patapsco, Md.	San Francisco, Cal.	Total.
		85	30	40		155
	9		36	60	41	146
	127	60				187
	40	28		42		110
	57	154				211
	58	205				263
		8				8
	199	113		7		319
	3	54		22	24	103
	82	80				162
	200	20				220
		20			15	35
	775	827	66	171	80	1,919

Table showing the different breeds of cattle and the number of each imported during the year.

Breed.	Number.	Breed.	Number.
Holstein	1,133	Ost Friesian	26
Galloway	236	Ayrshires	9
Jersey	170	Swiss	5
Angus	142	Normandie	2
Hereford	98		
Guernsey	54	Total	1,919
Durham	44		

The stations at Portland, Me., Coopersburg and Chester, Pa., and New Orleans, La., were abolished on the 1st day of July last. No cattle arrived at Portland after the station was transferred to the control of the Commissioner of Agriculture. The station at Waltham has been removed to Littleton, Mass.

No contagious disease appeared among the animals at any of the stations during the year, and the general health of all the cattle imported was good.

WHEAT CULTURE IN INDIA.

By Rev. I. L. Hauser.

ıdia is 1,900 miles in length and 1,500 in width, comprising an area ıl to that of the United States east of the Mississippi River. But ɜ wheat is raised south of the twenty-fifth parallel. The North- t Provinces and Oudh are best adapted to wheat culture. They prise an area of 106,111 square miles, almost a flat plain. The soil luvion, chiefly of clay and sand, deposited by fresh water, as there total absence of marine shells. Except in the mountainous range ıe Vindhyan chain that crosses the southern portion of these prov- s, there are no rocks, stones, or minerals other than silica and some which are in the finest particles.

ANALYSIS OF SOIL.

ıe following are the results of chemical analysis of soil from two dis- ɜs: Moisture in air-dried soil, first locality, 1.48; second locality, . Combined nitrogen, first, .11; second, .13. Sand and silicates luble in hydrochloric acid, first, 89.38; second, 84.70. Oxides of and aluminium, first, 4.11; second, 9.34. Lime CaO, first, .69; nd, .30. Potash K_2O, first, .68; second, 1.20. Soda NaO, first, .11; nd, .40. Phosphoric acid P_2O_5, first, .26; second, .19.

A FAVORABLE CLIMATE.

ıis is the most favorable climate in the world for agricultural prod- . The crops of the hottest and coldest countries can be grown . The seasons for different kinds of crops are fixed and regular, include the whole year, so that there is not a month in which the ıer may not work in his fields. The change from one season to an- ır is so gradual that there is no loss of product. On account of the ; and moisture all vegetable and organic matter are quickly fer- ted and changed into food for plant-life. The farmer receives im- iately a return for whatever he contributes to his fields, and the h upturned soil at once shows the beneficial atmospheric effect upon it.

THE TEMPERATURE.

The mean monthly temperature from 1882–'83 to 1884–'85, was as follows:

Stations.	April.	May.	June.	July.	August.	September.	October.	November.	December.	January.	February	March
	°	°	°	°	°	°	°	°	°	°	°	°
Meerut	82.0	90.4	91.3	86.1	81.7	80.3	72.0	61.0	54.9	54.5	58.7	72.5
Agra	87.8	95.8	93.6	90.2	81.7	82.8	76.9	67.1	60.3	59.6	61.8	76.5
Bareilly	84.3	89.9	89.3	84.9	81.7	81.1	73.2	62.5	57.3	55.7	61.9	72.4
Allahabad	87.0	93.5	92.0	84.8	82.2	81.8	73.9	62.7	58.2	60.3	61.1	77.2
Benares	87.1	92.1	89.0	84.9	83.0	81.7	75.3	64.8	59.3	61.3	63.2	77.1
Jhansi	88.7	96.6	93.1	83.4	80.3	79.6	76.3	68.0	62.2	64.2	68.9	78.9
Ranikhet	67.2	69.8	68.7	67.6	65.5	63.9	57.0	52.2	47.8	44.3	43.9	56.3

Ranikhet is a station on the Himalayas, a sanitarium for English troops, about 30 miles from the plains and at an elevation of 6,000 feet above the sea.

RAINFALL.

The following is the rainfall in inches for the last six years, from 1878–'79 to 1883–'84.

Stations.	Average, six years.	1878–'79.	1879–'80.	1880–'81.	1881–'82.	1882–'83.	1883–'84.
Meerut	40.3	44.5	49.4	40.1	36.7	32.9	44.0
Agra	24.5	21.8	34.4	15.6	24.4	26.7	15.5
Bareilly	39.1	37.4	64.2	35.6	34.5	41.1	18.5
Allahabad	29.5	29.6	69.7	18.4	32.8	30.9	20.4
Benares	35.5	21.4	50.0	37.8	30.9	37.8	28.2
Jhansi	29.6	21.2	25.5	19.8	40.0	41.2	30.0
Ranikhet	49.6	31.7	78.2	57.5	45.3	62.1	36.6
Average	35.5	29.9	50.7	32.1	37.4	39.7	32.7

The monthly rainfall for the same stations for 1883–'84 is as follows:

Stations.	April.	May.	June.	July.	August.	September.	October.	November.	December.	January.	February.	March.
Meerut	.07	1.14	3.88	5.54	.07	4.81	.....	.40	.04	.41	.69	.16
Agra	.....	.39	1.78	6.94	2.07	4.47	.....	.....	.....	.01	.01	.01
Bareilly	.62	1.30	2.74	7.69	3.99	3.78	.....	.12	.....	.....	.01	.06
Allahabad	.....	.61	2.50	13.70	3.19	5.98	.80	.....	.....	.66	.66	.01
Benares	.13	.24	5.90	11.39	3.57	4.08	.53	.....	.....	.....	.01	.01
Jhansi	.....	1.03	2.04	8.85	3.34	4.90	.48	.....	.....	.22	.45	.....
Ranikhet	.38	2.75	5.66	13.10	9.23	5.57	.22	.00	.06	.81	.52	.32

There are two grain seasons in a year in India; one is the rainy season, which commences about the 15th of June and continues until September and October.

The winter crops, such as wheat, oats, and barley, which are sown in October and November, are harvested in March and April. There are occasional showers during the winter, but seldom any from March to the middle of June. Between these two grain seasons the farmer gives his attention to fruit, vegetables, and sugar-cane.

CAREFUL CULTIVATION.

The farmer of India, without knowledge of science, without skill, nd with only a rude implement for a plow, yet in the most scientific anner, makes the atmosphere enrich his soil, for the atmosphere, to-ether with light, heat, and moisture, produces nitrogenous matter, and ne farmer, rooting or plowing his land twenty or thirty times before he ows his wheat, gives the soil a chance to feed upon this free, cheap, nd abundant food. The American farmer turns over his soil in the all, lets it lie a hard, compact mass all winter, and in the spring sows is seed upon the hard surface, thus slighting every aid to plant growth hat the atmosphere gives him. Take the average soil of these prov-nces to Minnesota, and it would be hardly worth cultivating. Bring he average soil of Minnesota here, and it could all be sold as a ferti-zer.

It is the "glorious climate" of India that is its greatest wealth, and he untutored son of toil makes use of it to the greatest advantage.

The land has been cultivated from time immemorial and still is not xhausted. The people, being so very poor and obliged to consume verything for themselves and their cattle and unable to import or pur-hase fertilizers, have but very little with which to feed the soil. That ttle is all used with the very best results. The experiments at the overnment experimental farm show that thorough plowing and timely fficient irrigation are after all the most important factors in production, nd they also show that a thorough upturning and exposure of the oil is sure to give in return a good crop.

There is something else in this exposure of the soil to the sun. When he rains begin, the air and earth abound with insect life. Scarcely a tep can be taken without treading on insects, crawling, running every-here, and while walking, riding, driving, there is a continual swarm f insects about one. At night, when the lamps are lighted, the tables r space about the lamps are covered with scores of kinds of insects, rom big moths down to midges. These are the seen and felt, but the nseen infinite myriads! With every plowing the soil must receive nuch of this animal life; with every shower of rain there must be an nsect shower, and with every breeze there must be myriads of lives recked upon the sticky clods of the plowed fields which make food for he coming crop. The living feed upon the dead.

HOW THEY TILL THE SOIL.

The India farmer has scarcely any tools, and what he has are of the plest kind. There being no hard, gravelly soil, no stiff clay, no hard-, and no sticky, calcareous soil to work, is a great advantage to . By a very crude implement, which can scarcely be called a plow, land is torn up. This plow consists of a triangular piece of wood, ut 18 inches in length, and 6 inches in diameter at the larger end, other being pointed. On the flat side of this bit of wood a groove ade into which a flat piece of iron, a foot in length, an inch wide, half an inch thick, is inserted and held in its place by a staple. The le underneath does not interfere with the rooting. This iron bar, ch is pointed, serves as a nose or point to the plow. The larger end his triangular piece of wood is mortised into an upright stick, the er about 3 feet in length, at the top of which is a wooden pin on the t side for a handle. About 18 inches from the ground a strip of rd 3 inches wide, an inch and a half thick, and 8 feet long, is in-ed into the upright stick, and serves as a beam and tongue. The e is a straight stick 6 feet long, 3 inches in diameter, with four wooden

pins, each 6 inches long, one on each side the neck of the bullocks. A small hemp rope or grass twine goes under the bullocks' necks to keep the yoke in its place. The beam of the plow has a few notches under it near the end, and is fastened to the yoke by a small grass rope or twine. The plow makes no furrow, but simply roots or tears up the soil, and the plowman with his little goad or whip in one hand, the other holding the wooden pin in the upright stalk, walks by the side of the plow. The cattle are of the Brahmini species, white, slender-bodied, long-legged, and about one-half or one-third the weight of oxen in the United States, and very lean, as about the only feed they get for mouths before the rains and during the plowing season is bhoosa, or wheat straw and chaff. To see a man weighing less than 100 pounds with only a strip of cloth around his loins and a like strip about his head, driving a little pair of lean cattle, swinging his whip and dodging from side to side of his plow, and calling his bulls by the endearing name of "my daughters," is quite a sight, especially when first observed by an American farmer. Plowing is hard work, both for the little cattle and the man himself, particularly if the ground is hard and baked, and if it is the first plowing. The best a plowman can do is to tear up three-quarters of an acre a day, and the work is poorly done. The land has to be plowed in this way a number of times, especially for the more substantial crops. The cattle cost from $5 to $20 a pair, but the average price of these working cattle in these provinces is about $8 a pair. The average cost of a plow is 40 cents. The only other implement used is a log or slab of wood, 6 or 8 feet long, drawn sideways across the field by one or two pair of cattle to crush the clods and smooth the surface. After the land is pulverized, and it is finally well done, too, the last plowing takes place, when a man or woman dribbles the seed from the hand into the furrow or mark after the plow.

REAPING AND THRASHING.

The reaper consists of a blade of iron 6 inches in length, 1 inch in width, and curved like an old-fashioned sickle, with a notched edge and a short handle. The cost of this instrument is 4 cents. The harvester sits upon his heels, cuts a handful of straw, which he lays down, then waddles on without rising, cutting about one-twelfth of an acre a day, for which he receives 5 cents, boarding himself. After this reaping-machine comes a binder, who gathers up the grain and binds it into sheaves about the size of the American sheaf. It is then shocked, and after a day or two carted to the thrashing-floor.

The thrashing-machine consists of a floor—a bit of hard ground—a stake, a number of cattle, and a driver. The grain straw is piled around the stake in the floor, the cattle are connected by a rope tied to their horns and one end of the rope fastened to the stake, and the driver keeps them going until the straw is tramped very fine into what is called "bhoosa." This, after the grain is separated from it, is fed to the cattle. The people raise almost insurmountable objection to any other mode of thrashing, as this is about the only way in which the straw is made into bhoosa. They do not only thrash to get out the grain but to break up the straw, and particularly to flatten it, so that the cattle will readily eat it. Mr. Ozaune, superintendent of agriculture in the Bombay presidency, had a large thrashing-machine sent from England, and de a contract with a landholder for 50 acres of wheat in order to try chine. After the work had commenced the landholder fell up knees and piteously begged for the thrashing to stop, as it w a ruin him, for the cattle would not eat the straw. A straw-cutter up the straw will not do, as they hold that it must be flattened and

ı as well as be broken up short. There is real force in this objec-
ıd, until it is overcome, the people will use the cattle and the
ing-floor. In time, when they can be induced to raise green fodder
serve grass as hay, or make ensilage, which is being introduced,
ıay adopt the civilized method of thrashing. Yet their system
very well. They have the cattle and plenty of time, for after
t they have less work to do and the straw is very dry.
winnowing-machine is a scoop, called a "soop," about 18 inches
nade of reeds, and in shape like a large dust-pan. This is filled
rain and chaff, and held in the wind so that the chaff falling
t is blown from the grain. If there is no wind, two men take a
t, one at each end, and wave it between them, while a third drib-
e grain from the soop. Twenty years ago the writer imported a
g-mill from the United States, and it was probably the first one
two hundred millions of people. To-day there is not a fanning-
ed by a farmer in all these provinces. There are some used at
ge markets. The cultivators are too poor to purchase them, and
ıdholders will not take the trouble or be willing to spend their
in this way.
r thrashing, the bhoosa is put in thatched ricks or bins, or in a
of their huts or mud-walled houses, and fed out very carefully.

THE MODE OF CULTIVATION.

first thing to do in preparing for a crop of wheat is manuring,
ı, if the farmer has any manure, and he generally saves all he
r his wheat. This is done in May or June, just previous to the
After the field has been plowed a flock of sheep or a number of
are herded on the field at night, and this costs the farmer some-
as he usually does not own any sheep. The least number of
he land is plowed is ten and the greatest number thirty. About
t of September the sowing takes place. First a Brahmin is con-
if the farmer is a Hindoo, to fix the auspicious time, and this
letermined he appoints a man to do the first sowing, after which
e can dribble the wheat, but not before. The farmer's wife, on
out the seed, reserves a little, to which she adds more grain, and
istributes it to the officiating Brahmin, the plowman, and labor-
he seed is carried in a basket and sprinkled behind the plow
ıe hand. The average amount of seed for an acre is 150 pounds.
ıe districts the wheat is carefully weeded, the weeds serving as
r the people and the grass as fodder for the cattle. In most
the fields have to be watered, and this has to be done, usually,
three times, first after the seed germinates, when the wheat is
to blossom, and the last when the wheat is in the ear. The aver-
st of watering, which is by different facilities and processes, is
$2.25 an acre. The harvest for wheat sown in October takes
n March, but usually the harvest-time is in April, the wheat
ıg in about five months.

THE COST.

bullocks	$8 00
	40
	15
	30
	06
ring scoop	06
	06
ifter	50
	9 53

The cost of raising an acre of wheat is:

Rent per acre	$3 60
Cartage of manure	1 20
150 pounds of seed	1 [illegible]
Plowing twenty times	[illegible]
Sowing by hand	[illegible]
Watering three times	[illegible]
Reaping and carrying	[illegible]
Thrashing	[illegible]
Winnowing	[illegible]
Total	10 [illegible]

If the land is not of the very best quality and near to the cultivator's village, the rent would be less than the above rate, sometimes less than half of it. In a full average crop the average yield per acre is 17 bushels for irrigated land and for dry land 10 bushels. The average price for wheat in the Northwest Provinces and Oudh during the last five years has been 68 cents a bushel. At this rate the 17 bushels would be worth $11.56 and the bhoosa or straw $3, making $14.56, leaving a profit of but $3.94 an acre; that is, if the farmer hires the work done; otherwise he gets paid for his own labor. Yet at the best he gets but little, as he has to give tithes to the Brahmin, the sweeper, the watchman of the village, and others. It is most fortunate that during two-thirds of the year there is something growing, weeds, vegetables, fruit, or coarser grain of some kind, or these poor people could never pull through. Give them only one crop, as in Minnesota, and one year would end their labors and their lives. These cultivators cannot afford to eat the wheat they raise. When they do eat it it is as a luxury and a treat. Their usual food is the coarser grains, herbs, weeds, vegetables, and cheaper fruits.

ACREAGE.

The area of wheat in the Northwest Provinces and Oudh is:

Divisions.	Normal area.	Area under wheat, 1883–'84.	Area under wheat, 1884–'85.
NORTHWEST PROVINCES.	*Acres.*	*Acres.*	*Acres.*
Meerut	1,195,328	1,206,510	1,257,[illegible]
Rohilcund	1,032,529	1,032,930	1,[illegible]
Agra	543,877	562,58[illegible]	[illegible]
Allahabad	220,618	223,232	[illegible]
Jhansi	68,180	67,602	[illegible]
Benares	403,654	541,109	[illegible]
Terai	33,767	54,627	[illegible]
Total Northwest Provinces	3,557,953	3,778,668	[illegible]
OUDH.			
Lucknow	306,379	306,379	[illegible]
Sitapore	421,894	421,894	[illegible]
Fyzabad	476,142	476,142	[illegible]
Roy Bareilly	203,815	203,815	[illegible]
Total Oudh	1,407,730	1,407,730	[illegible]
Grand total	4,965,683	5,186,398	[illegible]

Making the normal area 100, then the crop for 1884–'85 is 107, quite an increase over the previous year.

Kinds and area for 1884'–85.

Divisions.	White.	Red.	Mixed white and red.	Total.
NORTHWEST PROVINCES.	*Acres.*	*Acres.*	*Acres.*	*Acres.*
Meerut	469, 875	351, 607	436, 090	1, 257, 572
Rohilcund	222, 632	204, 621	671, 101	1, 098, 354
Agra	71, 636	119, 996	378, 632	570, 264
Allahabad	64, 142	90, 359	67, 528	222, 029
Jhansi	2, 589	79, 032	1, 761	83, 382
Benares	111, 196	336, 104	86, 618	533, 918
Terai	6, 327	31, 436	18, 833	56, 596
Total Northwest Provinces	948, 397	1, 213, 155	1, 660, 563	3, 822, 115
OUDH.				
Fyzabad	106, 480	133, 524	204, 180	444, 184
Sitapore	72, 462	355, 092	85, 601	513, 155
Lucknow	67, 333	154, 681	79, 137	301, 151
Roy Bareilly	23, 183	157, 044	37, 194	217, 421
Total Oudh	269, 458	800, 341	406, 112	1, 475, 911
Grand total	1, 217, 855	2, 013, 496	2, 066, 675	5, 298, 026

The amount of wheat for 1884–'85 is estimated to be as follows:

		Tons.
Stock existing at harvest		60, 000
Crop of 1884–'85		2, 100, 000
Total		2, 160, 000
Deduct food for coming year	1, 450, 000	
Seed for coming year	300, 000	
		1, 750, 000
		410, 000

Or 15,306,667 bushels for export from the Northwest Provinces and Oudh for 1884–'85.

Area and product for all India in April, 1885.

Political divisions.	Acres.	Tons.
PROVINCES.		
Punjab	7, 381, 400	2, 857, 099
Northwest Provinces and Oudh	5, 208, 026	2, 100, 000
Central Provinces	3, 700, 000	817, 857
Bombay	2, 670, 000	590, 183
Berar	819, 057	135, 770
Total	19, 868, 483	6, 500, 909
NATIVE STATES.		
Bengal	850, 000	336, 920
Rajputana	2, 250, 000	517, 857
Central India	3, 500, 000	500, 000
Hyderabad	750, 000	12, 420
Mysore	21, 740	2, 757
Cashmere	500, 000	133, 333
Baroda	80, 000	8, 900
Total	7, 951, 740	1, 512, 187

From the above it appears that the area under wheat in the whole of India for 1884–'85, was 27,820,223 acres, and the total tons yield for the year was 8,013,096, or 299,155,584 bushels. The increase in acreage under wheat in 1884–'85 over 1883–'84 in the Northwest Provinces and

Oudh is 111,628 acres, and this is not by the decrease of the acreage of other crops, but mostly in the taking up of new land. A similar increase was probably made in the other parts of India.

EXPORTS.

The exports of wheat from India for the past six years, as shown in the annual trade reports, are as follows:

	Tons.
1879–'80	109,777
1880–'81	372,718
1881–'82	993,176
1882–'83	707,220
1883–'84	1,047,824
1884–'85	792,714

As the export for the present year is not yet completed the total may equal twice the amount stated above, or 1,500,000 tons or 56,000,000 bushels.

PORT OF SHIPMENT.

The following table shows the amount of wheat exported from each port during the past four years:

Ports.	1881–'82.	1882–'83.	1883–'84.	1884–'85.
	Tons.	*Tons.*	*Tons.*	*Tons.*
Calcutta	333,402	221,970	380,576	128,180
Bombay	566,429	347,887	448,530	449,655
Kurachee	92,619	136,616	218,642	214,719
Madras	549	329	76	66
Rangoon	177	418	.....	154
Total	993,176	707,220	1,047,824	*792,714

*Export not complete. The amount for this year will be probably twice the amount above given.

WHERE IT WENT.

The countries to which the exports were made are:

Countries.	1881–'82.	1882–'83.	1883–'84.	1884–'85.
	Tons.	*Tons.*	*Tons.*	*Tons.*
United Kingdom	468,961	328,758	525,413	372,240
Belgium	131,261	72,944	129,678	86,284
France	265,403	178,385	169,895	165,742
Holland	35,619	28,912	9,637	4,627
Italy	17,966	8,806	22,276	35,645
Egypt	45,954	39,977	165,299	110,535
Other countries	28,012	49,438	25,626	17,521
Total	993,176	707,220	1,047,824	*792,714

* Export not yet completed.

TRANSPORTATION.

Until lately the greatest obstruction to wheat raising in India was the difficulty of transportation. Formerly the wheat was mostly used for local consumption, as the people could not afford to pay the increased

ıused by the transportation for long distances. This has now been d by the construction of long lines of railway. Prices for differ- rts of India are somewhat equalized, and foreign markets now the local prices. To show the difference in transportation, a llock cart will carry thirty maunds, 2,400 pounds, or 40 bush- niles in one day for 1 rupee, or 40 cents, which is 1 cent a bushel niles, or a bushel 1 mile for one-twelfth of a cent. At this rate wheat from Cawnpoor by bullock cart to Calcutta, a distance of es, would cost 57 cents a bushel. The freight per ton by rail ıe distance is $5.76, or 15.43 cents a bushel. This gives a differ- 41.57 cents on each bushel, the value of the railway to the shipper at Cawnpoor. Wheat shipped by rail from Cawnpoor to y, via Sabarmuti, a distance of 1,004 miles, costs 22.16 cents a when shipped from Cawnpoor via Jubbulpoor, a distance of 964 he rate is 28.91 cents a bushel, proving in this case that the way round is the nearest way home.

PRICES OF WHEAT.

›rices of wheat during the second week of May, 1885, were, per

At—	White.	Red.
	Cents.	*Cents.*
r	49	46
	51	46
	57	51
	46	45
poor	45	44
	50	46
	52	47

ay, 1884, the price of wheat in Cawnpoor was 68 cents per bushel. , 1885, it was 44 cents. The price in May, 1885, in Calcutta was s, and in Bombay 78 cents. In English money the price in Cal- as 21.88 shillings per quarter of 492 pounds, and in Bombay 24.57 s. Sea freights and other charges from Calcutta to London were illings per quarter, from Bombay 7.27 shillings per quarter, so uarter of wheat from these provinces landed in London from a cost 31.57 shillings, and from Bombay 31.85 shillings. The India wheat in London on May 16, 1885, was 34.5 shillings, ving a good margin to both the Calcutta and Bombay shippers. owing prices are for an imperial quarter, 492 pounds, during a f years:

Years.	India.	Great Britain.	Years.	India.	Great Britain.
	s. d.	*s. d.*		*s. d.*	*s. d.*
	33 7	46 11	1878	35 11	46 5
	22 7	56 8	1879	37 2	43 10
	24 2	57 0	1880	26 5	44 4
	25 0	58 8	1881	22 3	45 4
	22 9	55 9	1882	23 4	45 1
	19 11	45 2	1883	23 5	41 7
	19 7	46 2	1884	22 8	35 8
	25 11	56 9	1885	21 7	34 1

A COMPARISON.

A competent writer here makes this comparison (Delhi is 890 miles from Calcutta and 940 miles from Bombay):

	s.	d.
Cost of wheat per quarter at Delhi	20	0
Railway freight	6	6
Shipping	6	8
Total cost in London for 492 pounds	33	2
Cost of wheat in Chicago per quarter	32	11
Railway freight, Chicago to New York	6	2
Ocean freight, New York to London	2	4
	41	5

If this is a true estimate of the American cost and charges it shows much in favor of India. Mr. J. E. O'Conor, assistant secretary to the Government of India, financial department, in reviewing the export trade, says:

"It has been more than once pointed out in these reviews that the trade in Indian wheat must be one of a very uncertain and fluctuating character. Its continuance, on a very large scale, depends on the concurrence of a number of circumstances: (1) Abundant crops in India; (2) crops below the average in the United States and in Europe; (3) low rates of freight; (4) low rates of exchange. When all these exist together the supply of Indian wheat which will be put on the consuming markets will astonish, as it has astonished, those who are but imperfectly acquainted with the capacity of India for the production of this grain. When one or the other of them fails, the margin of profit, which is so slender at the best that exporters must work on a very extensive scale to obtain appreciable returns, shrinks in such a degree that the export will be carried on either to fulfill engagements already entered into or, as an unavoidable alternative to paying for imports in money. This year the second of the factors which must be present to make the wheat trade profitable has been absent. The harvests have been abundant in the United States and Europe, stocks in hand are large, and the supplies in existence or in prospect are so considerable that the price of wheat in England has fallen to as low a point as has been known for a hundred years. Prices have not similarly fallen in India, though it has been stated in a very positive way that India can produce wheat at a much lower cost than the United States—an assertion to which I venture, for reasons given, to demur altogether—the fact remains that India in her present circumstances cannot afford to sell her wheat with profit for the price offering in London of 37 shillings a quarter and even less. The average price of wheat in London has been, in 1880, 44*s.* 4*d.*; 1881, 45*s.* 4*d.*; 1882, 45*s.* 1*d.*; 1883, 44*s.* 11*d.*, and 1884, 37*s.* 8*d.* In the first week of 1884 the average was 39*s.* a quarter, and by the end of February it had gone steadily down to 36*s.* 11*d.* Then there was a rise to 38*s.* 1*d.* by the end of March, and the average for the three months was 37*s.* 9*d.* In April it was 37*s.* 2*d.*, and in May 38*s.* 2*d.* The price fell to 37*s.* in June, and then for the three months was only 37*s.* 6*d.* a quarter. Since then prices have actually fallen as low as 34*s.* a quarter. Now, to leave a profit at all, Indian wheat must sell for 39*s.* or 40*s.* a quarter, when prices in India and freights are both low."

An Indian daily paper, commenting on the above, says:

"The Indian wheat-grower may derive some consolation from the knowledge that if the American farmer has this year prevented the ex-

ort of wheat from India he has ruined himself in the process. Nothing clearer than that wheat cannot be grown at a profit in the United States the selling price is less than 33s. the quarter in the London market. With the present rates for wheat in Europe, the American farmer is simply ruined, and the American papers have shown conclusively that the Western farmers are getting less for their wheat at the place of production than it had cost them to grow it. * * * Another year of equally low prices would shut up thousands of farms in the far West, and already it is reported that the area under wheat this year in the States is 5 per cent. less than in 1883 and 1884. The American farmer is obliged to force his wheat on the European market, as he must convert his produce into cash, and there is comparatively no internal demand in his own country for it. * * * The Indian producer grows a variety of crops and can sell the most profitable produce and store the rest. When wheat prices fall, he buries his wheat and takes his sugar or his barley to market. Again, there is a great internal demand for wheat in India, and this is capable of great expansion whenever wheat is cheap. Thousands of persons in every district will eat wheat in preference to barley or bajra (a kind of millet) whenever it falls below 20 seers a rupee, which is 1 cent a pound). As it rises above this rate the internal consumption contracts. * * * The producer is getting lower prices than he probably expected, but he is not being ruined like his American rival, and he is getting a better price at the place of production than the latter. If Indian wheat prices were regulated as American wheat prices are, solely by the English market, and if Indian wheat had to be sent to Europe for sale at any price, we should then witness ruinously low prices in the up-country markets."

VARIETIES OF WHEAT.

There are a number of varieties of wheat in India, but they may generally be classed in the markets as of four kinds, white or red, hard or soft, and this classification is recognized in the European markets. The soft white wheat, which commands the highest price in Europe, is grown extensively in Northern India, Rajputana, and Gujurat. The soft red comes next in value and is grown in the Central Provinces. Formerly the hard wheats were preferred by the natives, but the European demand for soft wheat has so influenced the price as to have changed the taste of the natives.

The principal foods are wheat or barley, millet, and rice, which are estimated as follows:

Province.	Percentage, food-growing area.			Total population.	Population eating rice.
	Wheat & barley.	Millet.	Rice.		
Punjab	54	41	5	20,000,000	1,000,000
Northwest Provinces	57	34	9	42,000,000	4,000,000
Bengal and Assam	.....	.....	.....	66,000,000	44,000,000
Central Provinces	27	39	34	8,000,000	3,000,000
Berar	17	82	1	2,000,000	.....
Bombay	7	83	10	17,000,000	2,000,000
Madras	.....	67	33	31,000,000	10,000,000
Burmah	.....	84	16	5,000,000	1,000,000
Total	.....	.....	.....	191,000,000	67,000,000

GOVERNMENT ENCOURAGEMENT.

Every effort is being made to encourage wheat culture in India. Long lines of railway have been built with the wheat transportation in view. The Government has given special privileges to those taking up new lands, especially in the Terai. This is a tract of land from 20 to 30 miles in width along the base of the Himalayas. It is most excellent land for wheat. I have seen it yield 40 bushels to the acre, and of the finest berry. This Terai is, however, a sickly spot, and it is almost impossible for any one to live in it during the rainy season. The cultivators, usually from the mountains, go to their homes in June, before the rains set in, and return in September, in time to sow the fields which they had plowed before going away.

IRRIGATION.

Great efforts have been made by the Government to utilize water for irrigation purposes. In the south of India tanks are numerous. In Mysore the number is reckoned at 38,000 and in the Madras presidency twice that number. Some of them are large and might be called lakes. One in Mysore, the largest in India, is 40 miles in circumference. There are also many canals. The Ganges Canal, leaving the Ganges River at Hurdwar, which, including its branches, is about 900 miles in length, irrigates 1,200,000 acres, and cost £3,000,000; the Agra Canal, which leaves the Jumna River at Delhi, irrigates 225,000 acres and cost £800,000; the Bari Doab, in the Punjab, from the river Ravi, 465 miles in length, irrigates 250,000 acres and cost £1,500,000; the Soane Canal, from the river Soane, in Western Bengal, irrigates 300,000 acres; the Sirhind, on the Satlej, cost £2,750,000; the Caveri irrigates 820,000 acres, costing £116,000; the Kistna, 235,000 acres, costing £463,000; the Godaveri, 530,000 acres, costing £736,000; the Orissa, 98,000 acres, costing £1,450,000. Many of the rivers and streams are turned from their channels during their flow. In the Punjab about 900,000 acres are irrigated in this way and in Sindh 1,800,000 acres. The most important method of irrigation is by wells, and they are very numerous in every locality. The permanent wells, lined with brick, cost from $40 to $250 each, according to the depth, one 30 feet deep and 5 feet in diameter costing about $100. The temporary wells without curbing are abundant, but usually last only for one season. Persian wheels and leather buckets are used for these wells. A Persian wheel and two pairs of bullocks will irrigate 20 acres, but these wheels are only adapted for wells less than 20 feet in depth. A leather bucket and one pair of bullocks will irrigate an acre in five or six days, or 4 acres a month. In the Punjab, out of 21,000,000 of cultivated acres, over 5,600,000 are irrigated, as follows:

Method.	Acres.
By wells	2,176,000
Perennial canals	740,000
Inundations	933,000
Small canals and streams	642,000
Ponds	143,000
Total	5,634,000

ıé Northwest Provinces and Oudh there are 36,000,000 of
ıcres; of these there are irrgated:

By—	Northwest Provinces.	O
	Acres.	*A*
.....	4,480,000	1,
.....	1,694,000	.....
.....	1,984,000	1
al	8,158,000	8,

ng a total of 11,454,000 acres.
following table shows the percentage of irrigated land thr
lia:

Provinces.	Area ordinarily cultivated.	Area ordinarily irrigated	P a
	Acres.	*Acres.*	
.....	21,000,000	5,500,000	
it Provinces and Oudh	36,000,000	11,500,000	
.....	34,500,000	1,000,000	
rovinces.....	15,500,000	770,000	
.....	6,500,000	100,000	
.....	24,500,000	450,000	
.....	2,250,000	1,800,000	
.....	32,000,000	7,300,000	
.....	5,000,000	800,000	
al.....	177,250,000	29,220,000	..

.he irrigated land 8,000,000 acres are by the better class o
works, 12,000,000 by wells, and the balance by the temp
els and canals.

AREA AND POPULATION.

United States has an area of 2,970,000 square miles, exclu
a, and a population by the last census of 50,155,783. In
that under British rule, contains 877,950 square miles, an
st census contains a population of 198,508,795. Including n
indirectly under British administration India has an ar
423 square miles and a population of 252,660,550. The U
has an average population of 17 to the square mile, Britis
6, and including the native states, 171 to the square mile.*

CONCLUSION.

oncluding I will state what I think are the advantages and
of wheat raising in India: (1) The wonderfully permanen
eness of the climate and soil. (2) The use of irrigation, on ac
ch there can be no failure of the growth of a crop. (3) T
s for inland transportation and cheap ocean freights. (4
y of seasons, giving the farmer work in the fields every mo
ar, thus making the wheat crop almost an extra or surpl

ıres as to area and population of India do not exactly agree with offi
ED. REP.

the other crops supplying the laborers with food. (5) The cheapness of labor. All these combined indicate that the wheat-growing power of India will largely increase. The Government is planning in every way to increase the facilities of irrigation, introducing new seed and improved methods of culture, and also urging that freights on wheat by the state and other railways be greatly reduced.

The drawbacks are: (1) Heavy storms of wind and rain that cause the grain to lodge just before harvest, when it quickly spoils in the hot sun. (2) Heavy hail storms, and in some localities frost. The hail breaks the stalk or thrashes out the grain. (3) Rust, flies, and locusts or grasshoppers. All these greatly affect the crops at times, but they are accidents and expected to occur only occasionally.

TRUCK FARMING.

By A. OEMLER, *Wilmington Island, Chatham County, Georgia.*

HISTORY.

The forcing of fruit and vegetables, like nearly every other art, had
s origin in the desire to supply a demand. Merely the acceleration
maturity by shelter, exposure to the sun, and other means was
obably practiced at an earlier date, but the actual luxury of forcing
getable productions was first practiced by the Romans. Columella,
artial, and Pliny tell us that "spicularia," or plates of talc or mica,
ere utilized for the purpose of forcing cucumbers in order to gratify the
ste of the Emperor Tiberius (died A. D. 37) for that vegetable through-
t the year. By the application of hot water to the soil and hot lime-
nes near the roots cherries were ripened near Poitou, in France, in
e sixteenth century, and sent to Paris by post on the 1st of May. In
e following century peas were forced to maturity by exposing the
nts in boxes to the warm sun during the day, and protecting them
der the shelter of the gardener's house during the night; and in a let-
dated May 10, 1706, Madame de Maintenon speaks of new peas hav-
g been the principal subject of talk at the French court for four suc-
ssive days.

In the vicinity of important towns in every country where market gar-
ning is extensively pursued for the purpose of supplying the population
th fruit and vegetables, competition in the production of the earliest
ops has always been the most interesting and lucrative feature of the in-
stry. Such was the case until recently near all the large American cit-
s. About thirty years ago market and farm gardening on Long Island
d in New Jersey, to supply the rapidly-increasing wants of the growing
pulation of New York City, was very profitable. Its pursuit frequently
nferred competency and wealth, notwithstanding the farm land was
metimes worth from $200 to $1,000 per acre. In this, as in other coun-
es, rapid, frequent, and regular steam transportation has revolution-
ed all this, and now the higher prices of early produce accrue to gar-
ners of southern latitudes at a distance of hundreds of miles, who
ltivate land averaging not more than one-fifth the value, and, in con-
quence of the warmer climate, at less expense. In fact, market gar-
ning on Long Island has recently become comparatively so unremu-
rative that many of those formerly pursuing that branch of husbandry
ve turned their attention to dairy farming. The distance seems to
tend with the increased demand and with the improved transporta-
n facilities. At first Norfolk became the principal and nearly the only
at of production for the supply of the Eastern markets. Within the
few years competition from more southern localities has, however, in
subjected Norfolk, although in less degree, to similar experience,
the acreages of several of the most remunerative crops have been

reduced in favor of those less able to endure the dangers of transportation, and consequently less likely to be extensively grown at extreme Southern points. At present truck farming is pursued along the whole Atlantic coast down to Key West and around that of the Gulf to Mobile and Galveston, reaching even beyond the confines of the United States to New Providence and the Bermudas. The same circumstances prevail in Europe. Formerly England and some of the continental countries merely went beyond their own boundaries for a supply of early fruit and vegetables; then France and Spain became the sources of supply, but now Algiers, beyond the Mediterranean, is the most southern, and therefore most profitable truck-farming locality. A few fruit and vegetables may occasionally have been sent North from Georgia, but the first crop, exclusively for the purpose of shipment to Northern markets, was one of watermelons grown by E. B. Barstow, of Wilmington Island, Chatham County, in 1852.

In the preceding summer a party embarked on board the packet Isaac Mead (Captain Brown) for New York, and for their use during the passage he placed on board about fifty fine melons. Only a few having been consumed, the captain, to whom they were presented, sold the balance at such high prices, that Mr. Barstow conceived the idea of making the venture. Notwithstanding many drawbacks, it resulted so satisfactorily that other sea island cotton planters of neighboring islands, notably Col. W. R. Pritchard, of Skidusay, and Judge R. T. Gibson, of Whitmarsh, became tempted to do likewise. These, and a few others on a smaller scale, continued to plant melons for shipment. When the war commenced W. R. Pritchard had 60 acres in melons. None were grown in Southern Georgia along the line of the Savannah, Florida and Western Railroad until 1876, when George R. McRee, near Valdosta, and W. R. Tally, at Ousley Station, Lowndes County, became the pioneers of an industry in that section, which has reached such enormous proportions as to tax the carrying capacity of the transportation companies to the utmost.

Truck farming, or the growing at the South exclusively for the Northern markets, as a distinct business, of all or a selection of such fruit and vegetables as would be likely to arrive at destination in good condition and meet with a ready sale after having endured the dangers and vicissitudes of transportation to market, was commenced at Norfolk, Va., by some Jerseymen about 1858, near Charleston and Savannah about 1856, but not in Florida until 1870, and five years later still at Mobile. Without the results of the civil war between the States it never could have reached its present proportions. While in point of fact it was carried on to some extent before the war, emancipation may be considered really the birth of truck farming on an extensive scale. It was not an industry that could have recommended itself to rice planters, and these were the only agriculturists owning large forces of slaves in the vicinity of the large Atlantic coast cities, nor would any of them have for a moment entertained the proposal of hiring their hands to truck farmers. I was the largest slave-owner previous to the war engaged in the business in the neighborhood of Savannah, and, unless I had availed myself of house-servants and mechanics, at no time could I have commanded a larger labor force than twenty-six adults, male and female. Now several of the larger truck farmers there employ hands during the picking season by the hundred.

In 1870 J. R. Young had 150 acres in strawberries near Norfolk, and he required in the neighborhood of 1,000 hands to pick the berries. The daily yield of berries near Norfolk is estimated at between 4,000

nd 5,000 bushels, and, as 50 quarts is above the average daily picking, t follows that at least between 2,560 and 3,200 hands are indispensa- ble to gather this single crop. The late ex-Governor Hammond, of South Carolina, correctly predicted that in case of emancipation the negroes would collect in groups upon the outskirts of the towns, and it s the better class of this population, willing to perform some work, hat supplies the truck farmer with the needed labor. This is fortunate for society as well as for the negroes and truck farming, or some of his other predictions might also have become realized, for the industry gives occupation and support to a large proportion of these otherwise dle people.

LABOR.

Truck farming being but a branch of the general agriculture of the South, it is to the same God-given instrument, the negro, the farmer must look for his labor. It is rarely, even in the vicinity of Norfolk, that recourse is had to any other race. The pernicious share system has never yet invaded truck farming. Hands are paid generally in the vicinity of the cities every Saturday evening, at a certain daily rate, and if honest work is expected and no idleness or loitering permitted, full justice and prompt pay should be, and generally is, forthcoming. According to the Annual Report of the Department of Agriculture for 1879, the average rate of monthly wages on the plantations in the interior of Georgia was $10.73 without board. When the truck farmer hires by the month, which is rarely done, he pays about $12 with rations. The usual daily rate from Mobile to Norfolk is 50 to 60 cents per day for women and 60 to 75 cents for men without board. At Savannah it is 50 cents and 60 cents, respectively. A few trustworthy hands, particularly valuable during the marketing season, or those attending to stock, may receive a slightly increased pay. Some farmers pay selected hands 5 cents per basket for picking cucumbers and tomatoes, and 1 cent additional per crate for packing them, while others employ the gang for the pose, depending upon their personal supervision to have it done properly.

The table below gives the usual rate for the labor mentioned:

For—	By the day.	Picking large peas, per bushel-basket.	Picking early peas or beans, per basket.	Making crates for beans or peas, per 100.	Making crates for cucumbers or tomatoes, per 100.	Picking strawberries, per quart.	Packing strawberries, per quart.
	Cents.	*Cents.*	*Cents.*		*Cents.*	*Cents.*	*Cent.*
Men	50 to 75	12½ to 15	20	$1 00	75	1½	1
Women	50 to 60	12½ to 15	20	.....	.....	1½	1

The hours of labor are from sunrise to sunset, with variable allowances for meals during the different seasons.

LOCATIONS.

As no crops of vegetables satisfactory either in quantity or in quality, and consequently in pecuniary returns, can be produced with- li al applications of manure, nor when grown can be safely con- to market and offered to the trade without convenient transpor-

tation facilities, it follows that the vicinity of the larger seaport cities, whose commercial relations with the North suffice to support regular and frequent steamship communications, must offer the best locations for truck farming. Here the public livery, trade, dray, and street railroad, and the private stables, as well as the scavenger departments, supply large quantities of manure. The greater the proximity to the city the better will also be the labor supply. Increase of distance involves not only loss of time at every communication between the farm and the city or the point of shipment, but possibly more or less damage to the produce by the shaking and jolting of wagon transportation. It is for this reason mainly that locations further removed may be profitably made available on the banks of rivers or streams, where water transportation may be effected. If truck farming could be confined to these favorable locations, all the truck grown could command better prices, the average returns would be larger, and the business would be more remunerative, both to grower and consignee. This would obtain not so much in consequence of the smaller aggregate of producers, but on account of its superior quality when grown under favorable auspices, and not after having been subjected to injury attendant upon longer transportation. It is invariably the result that truck of poor quality tends to depress the market, whatever may be the quantity of stock on hand at the time. It is for this reason that along the line of the Savannah, Florida and Western Railroad, trending south from Savannah, very little crate stuff is grown.

The wonderfully favorable climate of Florida for the growing of early fruit and vegetables with the least expenditure of care and money, incites and enables her farmers to compete with those at nearer and otherwise more favorable points, but even then they are restricted to the smaller choice of the best-carrying articles. Even shipments of these often arrive at destination in such terribly bad order as not only to be total losses to the grower, but to damage other stock with which they are sometimes stowed on shipboard. I have, for instance, seen Florida tomatoes at the wharves of the Ocean Steamship Company in Savannah awaiting shipment to New York, already in such terribly decayed condition that the juice was dripping out of the packages in sufficient quantity to form little puddles on the flooring of the wharf.

Finally, cotton planters along the lines of the various railroads have attempted truck farming as an adjunct to their regular and more important operations, as a rule, however, with disastrous results, simply because nearly all the conditions essential to success were absent. It may be that small returns for crops grown under such circumstances and received at a season when cash is most acceptable would content the cotton planter. We are taught in truck farming, as in all other pursuits, either by our own experience or that of others, to utilize to the best advantage all the means and conditions essential to success, so as to make the most of opportunities, leaving nothing to chance or accident; but most of the cotton planters who embarked in truck farming ignored all the teachings of experience of others and, therefore, courted failure by attempting to produce these special crops with ridiculously inadequate manuring, a total want of knowledge in growing, harvesting, handling, packing, and marketing them, and without convenient transportation facilities.

It may be remembered that during the summer of 1881 severe drought prevailed over all the Northern and Northwestern States, cutting short such crops of vegetables, among others, as are stored for winter use. The domestic stock of beets, carrots, turnips, cabbages, and potatoes became,

herefore, exhausted comparatively very early in the winter, so much so as to encourage large importations from Europe. In consequence of his universal scarcity of vegetables the spring shipments of truck met an urgent demand and prices ruled unusually high. The year was also otherwise an exceptionally favorable one, fortune seeming to smile upon truck farming, for the season had been very propitious for the production of bountiful crops of excellent quality. Widely circulated reports of these facts gave rise to the so-called "boom" in truck farming, exciting the cotton planters to embark in the industry more extensively than was prudent, in most cases without any experience. Unfortunately, too, for the venture, the highly unfavorable season of 1883, combined with the reasons above mentioned, to cause a very general failure, but few of the planters having realized satisfactory returns.

SOIL AND ITS PREPARATION.

No truck farmer will achieve any considerable success unless he avails himself of all the means in his power to produce crops of the highest attainable quality as well as satisfactory quantity. He must not only have a good soil and render it highly fertile, but he will have to put it in a condition of agricultural excellence by perfect drainage, judicious plowing, harrowing, and stirring with the smaller implements of tillage during cultivation, so as to render it mellow and aerated in order that as large a percentage, not only of whatever plant-food in the form of fertilizers he intrusts to it, but also what is already stored in it, may become available during the entire growth of his crops. He may commit to his land an abundance of all the elements of plant-food, but unless well prepared by drainage and the implements of tillage, as far as practical results are concerned, it will be too sterile to produce remunerative crops, because it holds too much in an insoluble, unavailable condition to promote crop growth. It is principally the surface soil that supplies vegetables with food, and the farmer should remember that with every inch he adds to his enriched soil he gains per acre an enormous body (6,272,640 cubic inches), with its content of mineral ingredients, increasing its capacity of gathering, retaining, and rendering up plant food, besides encouraging a deeper penetration of the roots to find and absorb moisture during drought. Only loose, friable soil absorbs the moisture of dews, especially below the surface, and ammonia, carbonic and nitric acids from the atmosphere to any extent. Tillage may, therefore, be considered equivalent to manuring, inasmuch as it renders the soil not only fit to absorb elements of fertility from the atmosphere, but also brings into availability those already existing in it. The character of the soil will naturally affect the advisability or extent of deep plowing. Too much of a hard, tenacious clay should not be turned up to deteriorate the physical quality of the surface, and thus endanger its fitness as a good seed bed. A soil is heavy, in the language of the farmer, when it offers considerable resistance to the implements of tillage in consequence of its consistency or tenacity, and not on account of its weight or specific gravity. Thus clay is "heavy," although it weighs 26 pounds less than sand to the cubic foot, while sand is the light soil of the farm. Humus, however, is light in both respects. The weight of sand, clay, and humus, in a naturally moist condition, is, respectively, 141, 115, and 81 pounds per cubic foot.

The relations of these three constituents of every fertile soil to heat and moisture are of the highest importance to agriculture. The table below shows how they are comparatively affected by these agents, and

also their relative power of absorbing and holding matters dissolved in the water of the soil and their shrinkage in drying:

Characteristics.	Sand.	Clay.	Humus.
Permeability to liquid water	Greatest	Least	Less.
Capillarity or imbibition of moisture	Least	Less	Greatest.
Rapidity of evaporation	Greatest	do	Least.
Power of becoming warm	do	Least	Less.
Retention of heat	do	Less	Least.
Condensation of gases from the atmosphere	Least	do	Greatest.
Absorptive power of matters in solution	do	Greatest	Less.
Shrinkage in drying	do	Less	Greatest.

It will be seen from the relation of the soil to heat that one consisting principally of sand will necessarily be conducive to rapid growth, and, earliness being indispensable to success, it follows that a soil of such consistency would be for this reason preferred by the truck farmer. In point of fact a light sandy loam, with a considerable admixture of decaying vegetable matter, is the best adapted to this branch of agriculture. If the soil be deficient in the latter it may be most readily, most cheaply, and most expeditiously supplied by green manuring.

A light rain of half an inch is equivalent to a fall of 14,000 gallons, or 56 tons to the acre. Each pound of a manuring of 16 tons of stable manure would be supplied with half a gallon of dissolving water, and in case of the application of 1 ton of commercial fertilizer each pound would be furnished with 8 gallons of water. On a soil readily permeable to water the manure would be quickly dissolved, as it passes through in an aggregated form, thus bringing their food in an available form more quickly to the roots of vegetation. In consequence of its greater porosity the air is more readily admitted when sand is a constituent of a soil in considerable predominance, thus facilitating decomposition, solubility, and hence availability. In such a soil manure acts more quickly and more effectively; hence such a one is capable of producing a satisfactory crop with less manure than a heavy clay, notwithstanding the latter is naturally richer in all the elements of plant-food. As proven by Professor Way, chemist, of the Royal Agricultural Society of England, and others, clay not only possesses a wonderful power of absorption but actually suspends or prevents putrefaction. In his investigation on the "Power of soils to absorb manure," Professor Way says:

> Three quantities of fresh urine, of 2,000 grains each, were measured out into similar glasses. With one portion its own weight of *sand* was mixed, with another its own weight of white *clay*, the third being left without admixture of any kind. When smelt immediately after mixture the sand appeared to have had no effect, whilst the clay mixture had entirely lost the smell of urine. The three glasses were covered lightly with paper and put in a warm place, being examined from time to time. In a few hours it was found that the urine containing sand had become slightly putrid; then followed the natural urine; but the quantity with which clay had been mixed *did not become putrid at all*, and at the end of seven or eight weeks it had only the peculiar smell of fresh urine, without the slightest putridity. The surface of the clay, however, became afterwards covered with a luxuriant growth of confervæ, which did not happen in the other glasses.

Professor Way also found that putrefaction of urine would be prevented by merely filtering it through clay or shaking the two together and pouring off the liquor after it had settled. This action and its wonderful absorptive power is not attributable to the clay itself, but to the double silicate of alumina and lime or soda which it contains.

The remarkable and world-renowned experiments of that great agri-

ıltural benefactor, Sir John Bennet Lawes, assisted by Dr. Gilbert, ırried on with the utmost care for forty years, near Rothamsted, Eng- ınd, at his own expense, substantiate the fact that manures buried in ay soils become very slowly decomposed, and that such soils hold large uantities of plant-food locked up in unavailable form.

Number two of the twenty-nine experimental wheat plots has received uring forty successive years an annual application of 14 long tons of esh barn yard manure, or, since the first season of 1843–'44, an aggre- ate of 627.2 tons of 2,000 pounds, while plot No. 3 has remained con- nuously unmanured. Now, Sir John having kindly sent me a pamphlet ontaining the experiments up to the fortieth season inclusive, I find ıe last crop of the plot manured annually with 14 tons barn-yard man- re to have been 35¼ bushels, against 35⅛ bushels, the average yield of ıe first recorded sixteen years. In other words, after having been ıanured with 627⅕ tons barn-yard manure in the aggregate for forty ears, the soil produced only one-eighth of a bushel more the last sea- on than the average of sixteen years first recorded.

The result on the continuously unmanured plot is still more astonish- ıg. The yield the fortieth season was 13⅞ bushels and the weight f clean grain 61¼ pounds per bushel. The average yield of sixteen ears (1852 to 1867) was 14⅞ bushels; of the sixteen years (1868 to 1883) ; was 11⅜ bushels, and the average of the thirty-two years 13⅛ bushels; rith the weight of clean grain, 57¾ pounds per bushel. In other words, he plot, without the least manure of any kind, produced the fortieth eason only 1 bushel less than the average of the first sixteen, 2½ *more* han the average of the second sixteen, and three-fourths of a bushel *ıore* than the average of the preceding thirty-two years; and the weight f the clean grain per bushel the last season was 3½ pounds greater han the average of the preceding thirty-two years.

These remarkable results are attributable to the fact that the Roth- msted experimental wheat-field is a heavy loam with a subsoil of yel- »wish red *clay*, a rich, retentive soil with an abundance of plant-food »r the demand of many more such crops, becoming available very lowly notwithstanding the superior tillage practiced at the Rotham- ted experimental station.

The average removal of nitrogen in the wheat crops of the unmanured lot per acre per annum for thirty-two years was, by analysis, ascer- ned to have been 20.7 pounds. In 1881 six samples of the soil were ı yzed three times, 9 inches deep, from each of nineteen plots. The rst 9 inches of the continuously unmanured plot alone contained 2,404 unds of nitrogen in the 2,552,202 pounds of dry mold. Without aking into consideration the actual gain of nitrogen by the ammonia nd nitric acid in dews and rains, nor the probably heavier loss in rainage, we have, after the removal of the thirty-eighth crop, still nough left in the upper 9 inches of soil alone for one hundred and six- een more.

The explanation of the results of the plot manured annually with 4 tons barn-yard manure, lies in the fact that the fresh manure was rned under deeply, probably with a four-horse plow, as customary in England, where neither air nor water could find ready access to pro- »te decomposition and render it available for crops, thus leaving to clay its full power of suspending decay.

Had the manure been applied upon the surface, or harrowed into the soil, or had the soil been of a more sandy character, the results ld have undoubtedly been different.

Having learned that the method of deeply-plowing under their

manure prevails with many of the truck farmers near Norfolk, cultivating a rather heavy clay soil, I have treated the question intentionally at some length, and respectfully submit the above as arguments against the practice.

It is customary among truck farmers near cities to allow crab-grass to grow upon their well-manured fields after the crops have been taken off. It gives them several mowings during the season, providing them generally not only with an abundance of good fodder for their stock, but also with an income, for it sells, at least in Savannah, at $15 per ton. Unfortunately for the reputation of this crab-grass hay, the cutting is frequently deferred too late to secure the best quality. When sufficient time can elapse between the turning under of the stubble and the planting of crops for the ensuing season, it should by all means be permitted to decay and to form humus in the soil; otherwise, as in the case of crops like peas and potatoes, which are put in as early as December and January, it ought to be raked out, and may be used as bedding when dry, or put on the compost heap, or burnt on the ground if mixed with nut-grass.

MANURE AND ITS APPLICATION.

Without a sufficient supply of manure there can be no great success in truck farming, nor indeed, unless under very peculiar circumstances, in any other branch of agriculture. Market gardening requires its more liberal use than any other kind of husbandry. No satisfactory crops of vegetables, either in quality or in bulk, can ever be expected, however favorable all other conditions might be, without being well manured. There is no land in the United States, however fertile in its natural state, that would not produce more and better vegetables with liberal manuring than without it; indeed, land that might pay for cultivation without it would most deserve a liberal supply. The progressive truck farmer, therefore, should never allow himself to be restricted in its use by a short supply. When location, want of facilities for procuring a sufficiency of stable manure, or inadequacy of stock to secure enough barn-yard manure from its droppings, confines the farmer to an economical use of manure, recourse must be had to commercial fertilizers and to the agent hereafter to be mentioned.

If the manure be a complete one, like stable manure, containing all the elements of plant-food in beneficial relative quantity, with none in dangerous excess (as might occur with too much common salt, or in low grade kainit, too much dangerous chloride of magnesium, for instance), if the land be well stocked with humus and be in excellent agricultural condition, there is little risk of the Southern truck farmer applying such heavy doses to his land as to endanger his crops. The soil has heretofore been subjected too long to homœopathic treatment for any fears to be entertained on that score.

The truck farmer aims to stimulate his crops to rapid growth. They are all of earlier maturity than those of the grain or cotton planter. He is therefore compelled not only to use a much larger quantity of plant-food in his manurial applications than his crops can possibly take up, but his fertilizers must act quickly. He wants no permanent manures, but active, soluble ones.

In New Jersey and on Long Island the market gardeners apply from 70 to 80 tons of stable-manure to their early cabbages per acre, and, as the plants are set much closer and are much more sure to head universally than at the South, a yield of 50 tons to the acre is not an excessive ex-

imate. Below will be found a table giving the chemical constituents f 75 tons of stable manure and of 50 tons of cabbages, from which may e seen that the demands of such a crop are far short of the quantities f plant-food contained in the manure:

Constituents.	75 tons fresh stable manure.	50 tons cabbages.
	Pounds.	*Pounds.*
Nitrogen	820	240
Potash	795	630
Phosphoric acid	420	140
Soda	150	90
Lime	315	310
Magnesia	210	60

The kind of vegetable and closeness of the stand will usually determine the quantity to be applied; it has, however, become proverbial with the market gardener that "the last load pays best."

For all close crops, like cabbage and potatoes, requiring liberal fertilizing, at least a part of the manure should be broadcasted. The most successful truck farmers in the vicinity of Savannah, operating on an extensive scale, broadcast for these crops about twenty loads of 30 bushels each, using the Kemp & Burpee spreader, and an additional twenty loads in the drill, supplementing the latter with either 700 pounds best Peruvian guano, or half a ton of fish scrap per acre. This rich, moist, fermented manure, sometimes mixed with night soil, must weigh about 45 pounds per bushel, or 1,350 pounds per load, which would aggregate 27 tons of supplemented stable manure per acre. Neither in the application of manures, nor in any of his other operations, should the intelligent member of any branch of agriculture be empirical. The physical nature of his soil, and the peculiar root growth of any special crop, must govern him more than other considerations. As stated in the paragraph on soils, manure may be applied deeper in light than in heavy land. The general farmer will not manure his surface-rooted small grain and his tap-rooted cotton (which also makes deep lateral roots 12 feet long) in the same manner, nor should the truck farmer, on land of identical physical character, do so with his radishes or snap-beans, and his cabbages. No rule then will suit all cases. Generally it is advisable, however, whatever be the nature of the soil, to place at least a part of the manure where the roots of the plant in its first stages of growth may reach it, in order that it may acquire a youthful vigorous start. Manure may be placed more deeply for tap-rooted plants than for such whose roots ramify through the soil near the surface but do not penetrate it deeply.

Plants growing through the heat of midsummer are apt to send their roots deeper into the soil than those confined to an early season; but the crops of the truck farmer, with the exception of the watermelon—and that delights in heat and comparative dryness—are all of early maturity.

Many truck farmers are now adopting the plan of dividing the manuring, and claim advantages for the new method. They apply stable manure in the drill, and during growth, when the plant most needs stimulating, using an easily soluble ammoniated commercial fertilizer on each side of the rows. It is either applied on the surface and hoed in, or most frequently the crop is barred off and the fertilizer deposited in the furrows. In an essay like this space will not permit a dissertation on all the various manures and fertilizers which may be utilized in truck ning.

A few remarks upon the one which must always chiefly be relied upon everywhere in market gardening, stable manure; a few upon that grand material in which the lucky South leads the world in its fortunate possession, cotton-seed; and a few on green manuring with the cow pea will have to suffice.

Stable manure may be considered a complete fertilizer. It contains, when fermented, all the elements of plant-food in available form. The litter, or bedding, when decayed, supplies humus. No other manure is so well adapted to alter and improve the physical condition of tenacious soils, nor, when decayed, suits one of a sandy character better. All organic manures to be promptly efficacious, whether applied to light or heavy soil, should, at least, be partially decomposed, in order that the fertilizing elements may be in a more soluble or available form. Fresh or green manure, however, is better adapted to heavy than to sandy soil.

Composition of fresh and decomposed stable manure.

Description.	Water.	Organic matter.	Mineral matter or ash.	Nitrogen in organic matter.	Ingredients of ash.							
					Potash.	Soda.	Lime.	Magnesia.	Phosphoric acid.	Sulphuric acid.	Silica and sand.	Chlorine and loss.
Stable manure	710	246	44.1	4.5	5.2	1.6	5.7	1.4	2.1	1.2	12.5	1.1
Stable manure, moderately rotted	750	192	58.0	5.0	6.2	1.9	7.0	1.8	2.6	1.6	13.6	1.3
Stable manure, thoroughly rotted	790	145	65.0	5.8	8.0	1.2	8.8	1.2	3.0	1.2	17.0	1.6

There is considerable loss from exposure of the manure heap to rains, particularly to the heavy showers of the South, but it is rarely possible for the truck farmer to keep the large quantity he requires under cover. The following table is from Dr. Voelcker, of the Royal Agricultural College of Cirencester. There was but a small loss of nitrogen and a gain in the soluble organic matter, some of the insoluble organic matter having become soluble in the course of fermentation during the first six months of an English winter; but in our Southern climate the probabilities are that the deterioration would commence earlier.

Contents of a heap of manure at different periods exposed to rain, &c.

Contents.	Put up November 3.	Put up April 30.	Put up August 28.	Put up November 25.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*
Total weight of manure in heap	10,000	7,139	7,025	6,954
Water in the heap of manure	6,817	4,707	5,304	5,167
Total organic matter	2,824	1,678	1,064	917
Total inorganic matter	359	753	657	869
Total nitrogen in heap	64.2	62.9	46.8	46
Total soluble organic matter	248	305	207	199
Total insoluble organic matter	2,576	1,373	857	717
Soluble mineral matter	154	204	138	139
Insoluble mineral matter	405	549	519	730
Nitrogen in soluble matter	14.9	21.4	13.2	12.9
Nitrogen in insoluble matter	49.4	42.5	33.1	33.1

When stable manure is piled loosely and the air has ready access to the interior fermentation proceeds rapidly. Under the evolution of much heat the manure "fire fangs" and there is much loss of the volatile

onate of ammonia, which is produced during fermentation. It is acticable for the truck farmer to avoid this by turning his manure. ıre and compacting it to preclude the air will prevent the rapid entation and accompanying loss. The trampling of hogs may be e effective. Extensive truck farmers, located favorably near large s, preserve their large accumulations from this danger by daily de- ts of partly fluid night soil upon their manure, considerably aug- ting its value. The wagons are driven over the pile and the fre- ıt delivery tends to compact it. A recent city ordinance prohibits leposit of night soil within 3 miles of the city limits of Savannah; the nearer and otherwise more favorably located farmers are de- ed from this source of manure. Gardeners near cities, who collect ə quantities of stable manure by daily accumulations, rarely place ə than four hundred wagon-loads in a single pile, but prefer to have posited in suitable quantities upon the headlands of each field, re it may be convenient for application. By covering each pile, n finished and practicable, to the thickness of several inches with too rapid fermentation by exclusion of air would be prevented, and volatile and escaping ammonia would be absorbed by the covering h. The truck farmers located remotely from the cities may augment r manure piles by composting it with muck, frequently much richer itrogen than the best stable manure, woods, earth, or good garden thus preventing a too rapid fermentation; or they may use their ller stock of stable manure as a basis for compost heaps of every ible material which can, after decay, form plant-food. It will induce sustain the fermentation so necessary to break down these crude table materials in order that their elements may become available. manurial value of the excrements of all animals will depend upon constituents of their feed. A horse fed on corn or oats and good will void better manure than one fed on straw. Block estimated a horse will void 172 pounds fresh dung if fed on 100 pounds of hay, pounds when fed on 100 pounds of oats, and only 43 pounds if fed 100 pounds of grass. A single horse, if well fed, voids about 00 pounds of solid dung, and 3,000 pounds of urine annually. John- found that the manure of the horse-car stables in New York con- ed 0.53 per cent. of nitrogen. If two-thirds of both the solid and id excrements were saved during the year there would remain for horse 5 tons of manure containing 53 pounds of nitrogen. Accord- to the analysis of Dr. Emil Wolff 5 tons of stable manure contains ounds of nitrogen.

elow is a table, according to Professor Wolff, showing the amount itrogen, phosphoric acid, and potash in 1 ton of the fresh dung and h urine of different domestic animals:

Animals.	One ton fresh dung.			One ton fresh urine.		
	Nitrogen.	Phosphoric acid.	Potash.	Nitrogen.	Phosphoric acid.	Potash.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
.....	8.8	7.0	7.0	31.0	.....	30.0
.....	5.8	3.4	2.0	11.6	.....	9.8
.....	11.0	6.2	3.0	39.0	0.2	45.2
.....	12.0	8.2	5.2	8.6	1.4	16.6
Mean	9.4	6.2	4.8	22.5	0.4	25.4

With stable manure, as with every other commodity, the demand governs the price. When I commenced truck farming, in 1856, it could be had at some of the public stables for the hauling. Two years afterwards I paid $100 by the year for all the manure from the largest livery stable. At present it costs at the stables in Savannah 25 cents per dump-cart load and 50 cents for a two-horse load, thrown in without packing, or it is contracted for by the year at the rate of 40 cents per wagon-load.

At Norfolk, where so much is required, recourse must be had to distant points, and it is brought in schooners from New York, Baltimore, and Washington, costing by the cargo sometimes $1.50 per load of 20 bushels. A bushel of green manure, as it comes with the straw, &c., from the stable, weighs about 28 or 30 pounds. Delivered at Norfolk, a ton would, therefore, cost about $5. The Norfolk truck farmers, however, use large quantities of the best Peruvian guano.

According to figures given in the appendix to Harris's Talks on Manures, to which valuable work I am indebted for several of these data, the price of stable manure in Philadelphia is $9 to $10 by retail, or $7 to $8 by annual contract for four-horse wagon-loads of 2½ to 3½ tons. At this rate the highest price is $4 per ton. In New York City the average cost is $3 per horse, and it is delivered on cars or vessel at 80 cents per tub of 14 bushels. Mr. Peter Henderson says, if stable manure can be laid on the ground at $3 per ton, it is cheaper than commercial fertilizers of any kind at their usual rates. These comparisons of the cost of stable manure at various chief points of market-gardening show, not only that the truck farmers of Norfolk probably pay a higher rate for it than any tillers of the soil in the United States, but also how indispensable to success it is there considered.

COTTON SEED.

As the most indispensable requirement for the commencement of civilization of a people has been a fertile soil, it ought to follow that a people possessing, in a product of agriculture—from a source, therefore, inexhaustible—the most valuable fertilizing material, should be capable of the greatest progress. It is well said, "the more manure the more crop," but to no country can the reverse of the saying, "the more crop the more manure," be applied with as much force as to these United States of America. No crop is less exhaustive of the fertility of the soil than cotton, and none yields, as a secondary product, a material so valuable and so rich in all the elements of plant-food as cotton seed. It naturally follows, however, that as these valuable elements contained in this estimable product must have been derived from the soil, it devolves upon every patriotic, intelligent, and economic Southern farmer to see to it that they be returned to it in order to prevent the exhaustion of its fertility. Chemists have demonstrated by analyses, and farmers have corroborated the fact, that it is the most concentrated food for stock known, and after having been fed to animals, that the manure is richer in fertilizing matter than that resulting from any other food.

r is a table by Sir J. B. Lawes, showing the amount of phosphoric tash, and nitrogen in various foods, and the comparative value esulting manure:

Food.	Total dry matter.	Total mineral matter (ash).	Phosphoric acid reckoned as phosphate of lime.	Potash.	Nitrogen.	Value of manure from 1 ton (2,000 pounds) of feed.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	
l cake	89.0	8.00	7.00	3.12	6.50	$27 86
ke	88.0	7.00	4.92	1.65	4.75	19 72
	89.0	8.00	5.75	1.76	5.00	21 01
	84.0	3.00	2.20	1.27	4.00	15 75
	84.5	2.40	1.84	0.96	3.40	13 38
	88.0	1.30	1.13	0.35	1.80	6 65
	85.0	1.70	1.87	0.50	1.80	7 68
	86.0	2.85	1.17	0.50	2.00	7 70
n	86.0	6.60	7.05	1.45	2.55	14 59
	84.0	7.50	1.25	1.30	2.50	9 64
ay	84.0	6.00	0.88	1.50	1.50	6 43
w	84.0	5.00	0.55	0.65	0.60	2 68
	82.0	5.50	0.48	0.93	0.69	2 90
	11.0	0.68	0.13	0.18	0.22	0 91
rnips	8.0	0.68	0.11	0.29	0.18	0 86
oes	24.0	1.00	0.32	0.43	0.35	1 50

of course not claimed that under all circumstances the manure on of cotton-seed cake is worth $27.86, but that if the manure g from a ton of any of the foods named be as stated, then that g from a ton of cotton seed is worth in comparison $27.86.
s says the manure from a ton of undecorticated cotton-seed cake h $15.74 and that from a ton of cotton seed after being grouud ed, by which about 8 per cent. of husk and lint was removed, 1 $13.25. The following table of Dr. Emil Wolff shows how f the various elements contained in the food of animals is re- n their organisms and how much is voided in their excrements. 0 pounds of dry substance in the food, there is found in the ex- s:

Dry substance—	Cow.	Ox.	Sheep.	Horse.	Mean.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
g	38.0	45.6	46.9	42.0	43.1
e	9.1	5.8	6.6	3.6	6.3
l dry substance in the manure	47.1	51.4	53.5	45.6	49.4

0 pounds of organic substance in the food there is found in the nts:

Organic substance—	Cow.	Ox.	Sheep.	Horse.	Mean.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
g	36.5	43.9	45.6	38.2	41.0
e	6.0	3.2	3.9	2.5	3.9
l organic substance in manure	42.5	47.1	49.5	40.7	44.9

100 pounds of mineral matter in the food there is found ements:

Mineral matter—	Cow.	Ox.	Sheep.	Horse.	
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*P*
he dung	53.9	70.8	63.2	85.6	
he urine	43.1	46.7	40.3	16.3	
Total mineral matter in manure	97.0	117.5	103.5	101.9	

To the mineral matter in the water drank by the animals is du xcess of mineral matter over 100 pounds.

Of 100 pounds of nitrogen in the food there is found in the e ments:

Nitrogen--	Cow.	Ox.	Sheep.	Horse.	1
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*P*
In the dung	45.5	51.0	43 7	56.1	
In the urine	18.3	38.6	51.8	27.3	
Total nitrogen in manure	63.8	89.6	95.5	83.4	

The table shows at a glance what a small proportion of the m portant ingredient, nitrogen, is retained by the different animals therefore how valuable the manure of his domestic animals must the farmer generally, when fed on material so rich as cotton-seed sheep extracting only 1 in every 22 pounds. The percentages of gen thus taken up by the cow, ox. sheep, and horse are, respec 36.2, 10.4, 4.5, and 16.6. But cotton seed not only produces th valuable animal manure; it is itself one of the most excellent ers in existence. The merchantable meal of the oil-mills may to advantage by the truck farmers in the vicinity of cities to ment their stable manure instead of Peruvian guano. As a sol moniacal fertilizer for this purpose, in quantity sufficient to e same result, cotton-seed meal is much cheaper than Peruvian present prices and of present quality.

Truck farmers remote from a sufficient supply of stable ma without enough stock, can provide themselves with the bes substitute by composting cotton-seed meal with muck, wood any other vegetable matter. An addition of acid phosphate may sometimes be advisable.

Finally, if the soil be sufficiently supplied with decayin matter by the use of muck, &c., or the practice of green ma ton-seed meal may be profitably used alone, or in conjuncti phosphate of lime and kainit in the proportions (as advised White, the able State chemist) of meal, 500 pounds; phos 1,250 pounds; kainit, 250 pounds. If, however, applied its fresh state in any considerable quantity sufficient time for the most active process of decomposition to have passe seed are sown or plants put out, or injury will surely ensu with its radicle, or the roots of the latter, come in conta menting fertilizer. The same caution should be observe scrap or any such organic ammoniacal manure.

Under no circumstances should the whole seed, whethe whether fresh or fermented, be used as a fertilizer b

Southern agriculturist, be he cotton-planter, grain-grower, or truck farmer. nor should even the crushed seed unless the oil has been extracted. It would not only be a shameful waste, but the valuable oil, so far from being of the least benefit as vegetable food, actually retards decomposition of the albuminoids supplying nitrogen, and temporarily deteriorates the agricultural condition of the soil.

From September 1, 1884, to July 31, 1885, there were exported to foreign ports 90,154 tons of cotton-seed meal and cake, estimating the bag at 200 pounds, and coastwise 5,797 tons, most of which also went to foreign ports via New York, and were lost to the South. Allowing one-fourth to have remained in the United States we have, together, 94,502 tons of cotton-seed meal exported from New Orleans alone, involving a loss to the fertility of the South of 12,285,260 pounds of nitrogen, without probably any considerable compensation to the soil for the improving process.

The planter who uses his seed without prior extraction of the oil as manure buries with each bushel from 15 cents to 20 cents of *cash*. Is cotton planting an industry so prosperous as to afford such enormous waste?

The planter's remedy will be either to feed his seed and use the manure, to exchange his seed at the mills for meal, or, better still, to establish neighborhood mills, even if the oil be not so perfectly extracted, and secure both profits.

GREEN MANURING.

Many of the crops of the truck farmer will not prosper on poor soil, however it may be locally fertilized in the hill or drill, the long roots soon passing beyond the manurial effect of the application. This applies notably to Irish potatoes and cabbages. As truck farmers at a distance from cities are prevented by a limited supply from broadcasting their manure, the readiest, cheapest, quickest, and most efficacious mode of imparting this general fertility is green manuring. It could, however, be profitably practiced irrespective of the supply of any kind of manure. By using green manure in conjunction with cotton seed, acid phosphate of lime and potash, truck farmers, without a supply of stable manure, enjoy better chances of success than by any other system they could adopt.

Although organic matter in the soil is not considered indispensably necessary to supply carbonic acid to crops, its decay, when present, furnishes it to vegetation more quickly than it could be commanded otherwise. The benefits to the soil from the presence of humus is not, however, confined to the mere conveyance of its inherent elements of fertility, for its physical influences are probably even of more importance.

Decomposition commences in all organic substances as soon as life is extinct, and the richer these substances are in the albuminoids containing nitrogen, the more rapid will be the process, and the more valuable the products for the growth of vegetation. All green, succulent plants ferment readily and rapidly, hence the advantage of plowing under vegetation in its green state, if the land is wanted for a crop soon afterwards. Dry vegetable matter, containing hard, woody fiber, decays more slowly.

The leguminous plants are not only richer in albuminoids, and therefore best adapted for green manuring, but also in the other two chief nourishing ingredients, phosphoric acid and potash, than any other family of plants. At the North and in all cool countries clover has always had the preference for this purpose, but at the South the cow-

pea is a most valuable substitute. In one respect, that of flourishing in soil too poor to produce a crop of clover, it has the advantage of the latter. It is not only through the growth above ground that a green crop improves and enriches the soil, but also through the roots. It has been estimated that after the removal of a crop of clover and other plants, there remained in the soil the amount of roots shown below:

Table showing the quantity of roots left in the ground after harvesting the crops; also the amount of nitrogen and ash.

Roots of—	Stubble and roots (dry), per acre, to a depth of 10½ inches	Nitrogen, per acre	Ash free from carbonic acid, per acre.
	Pounds	*Pounds.*	*Pounds.*
Lucerne	9,678.1	136.4	1,201.6
Red clover	8,921.6	191.6	1,[illegible].9
Rye	5,264.6	[illegible].3	1,[illegible].8
Swedish clover	5,004.3	102.3	874.6
Oats	3,331.9	26.6	1,444.7
Lupine	3,520.9	62.2	550.0
Wheat	3,476.0	23.6	1,[illegible].3
English peas	3,222.5	[illegible].6	[illegible].7
Barley	1,091.4	22.8	391.1

Analysis of the ash of the roots in the table above

Roots of—	Lime.	Magnesia.	Potash.	Soda.	Sulphuric acid	Phosphoric acid.
Lucerne	197.7	24.2	36.7	26.4	18.7	[illegible].5
Red clover	262.9	48.4	58.3	20.0	26.1	74.[illegible]
Rye	73.2	14.3	31.2	43.3	11.8	24.4
Swedish clover	130.1	17.6	25.9	5.7	13.2	[illegible].2
Oats	85.5	11.2	24.8	18.0	[illegible].8	[illegible].0
Lupine	80.5	11.2	16.5	3.5	7.0	13.[illegible]
Wheat	76.7	10.1	28.4	11.0	7.4	11.[illegible]
English peas	71.7	11.0	11.2	7.0	[illegible].4	14.3
Barley	42.2	5.5	9.5	3.5	5.5	11.2

A crop of cow-peas would probably have a similar amount of roots and 24 tons of tops in the green state.

The following analyses were made by Prof. A. R. Le Doux, as chemist of the State board of agriculture of North Carolina:

Analysis of green cow-pea vines.

Constituents.	Per cent.	Constituents.	Per cent.
Water	72.87	Cellulose	[illegible].57
Ash	2.00	Fat	[illegible].21
Albuminoids	1.85	Carbohydrates	[illegible].85

Analysis of the ash of cow-pea vines.

Constituents.	Per cent.	Constituents.	Per cent.
Ash	2.00	Sulphuric acid	2.35
Potash	14.80	Silica	1.00
Soda	23.29	Chlorine	0.19
Magnesia	6.74	Oxide of iron	Trace.
Lime	22.57	Carbonic acid	18.70
Phosphoric acid	9.28		

Reduced to weight, 1 ton of fresh cow-pea vines contains:

Constituents.	Pounds.	Constituents.	P
ter	1,436.20	Carbonic acid	
ash	5.92	Albuminoids (containing nitrogen, 7.12 pounds)	
a	9.32	Cellulose	
nesia	2.70	Fat	
e	9.02	Carbohydrates	
sphoric acid	3.72		
phuric acid	0.94		
a	0.42		
orine	0.08		

Before enumerating the benefits to the soil itself from the ultim
sulting humus, those must be mentioned accruing to it from the
ade of a mass of growing cow-pea vines, and from their action
rds during the process of fermentation and decay beneath its sur
Boussingault examined snow which had remained on the soil of a
n for thirty-six hours and that which had just fallen upon an ad
g stone terrace. The former contained ten times as much amm
the latter, the mulch of snow having interrupted and absorbed
moniacal emanations from the soil. The ammonia of the soil is
ntly fluctuating. In dry weather it rises, dissolved in capi
ter, to the surface, and is partly lost into the atmosphere durin
ocess of evaporation, especially when the soil is bare of veget
otherwise is uncovered. In wet weather it is washed down de
o the soil, but fortunately not beyond the reach of roots, as ger
low 6 feet there is no trace of it. The dense covering of pea
ts like the mulch of snow, keeping the surface moist and inter
g the evaporation and loss of ammonia.

Sir J. B. Lawes examined the drain-water at Rothamsted and f
at it took from a field kept bare of vegetation at the rate of 40 po
r acre per annum; from a field of wheat upon which no weeds
er the harvest 25 pounds, and from a field upon which grass
d been sown with the wheat and continued to grow in the stu
ly 5 pounds.

Pounds of nitrogen washed away, per acre.

	I
om a soil without vegetation	
om a soil with wheat, 15 pounds retained by wheat	
om a soil with wheat and grasses, 15 pounds retained by wheat, 25 pounds by growing grasses	

Having analyzed the rain-water that had fallen at Rothamsted du
e period of the experiment, he found it had not contained as
trogen to the acre as was discovered in the drain-water.

The fact, however, of greatest importance to our subject of
nuring which he ascertained was, that during the fall the am
ammonia carried away in drain-water was greater than at any
ne of the year. It is just at this season and during winter tha
il of the truck, as well as other, farmers should be well covered
getation. The land of the truck farmers near cities is so well
red that the growth of grass answers this purpose; but, as the
e decays much more slowly than pea-vines, plowed under, either
dry, the latter even here would be preferable in not requiring
owed under so early, thus giving the soil the benefit of a longer m
At a distance from towns, however, where less manure having
ed, the surface of the often yet unrenovated soil is rarely suffici

covered with vegetation, hence the very great importance to Southern farmers of resorting to that cheapest, quickest, and best method of improving poor soil—green manuring.

The dense covering, then, of pea-vines shades the soil, preventing the escape of the soluble volatile elements of fertility with the vapor of water. It renders the soil mellow, moist, and of equable temperature, and, as a secondary matter, prevents the growth of noxious weeds. The state of moisture under the shade facilitates the disintegrating effects of carbonic acid upon the constituents of the soil, preparing them for plant-food, while darkness and moisture are conducive to nitrification. The decaying vegetable matter changes the physical textures of tenacious clay, rendering it more pliable. Humus imparts to the soil, more or less, its peculiar characteristics, increasing the porosity of heavy soils, letting in air and letting off vapor, and moistening dry, arid ones by its great hygroscopic or water-vapor imbibing power. Finally, ozone can only form nitrates in the soil when organic matter has passed into the comparatively stable condition of humus.

The question of turning under the pea-vines green or after they have been allowed to die on the ground is, like the vexed one of deep or shallow plowing, governed by circumstances. They will ferment and decompose more rapidly if turned under green, and it may be necessary, when the land is needed for a crop as soon as decay may have sufficiently progressed, to permit the planting. The advantage accruing to the land by the longer mulch will far outweigh any possible loss of fertilizing elements, if loss there be, and, besides, the plowing under will be very much facilitated by the previous partial decay of so large a mass of vegetation.

When the turning under in the green state is necessary, the vines, if of luxuriant growth, will first have to be leveled by a roller, or a harrow reversed, teeth upturned, and a large, two-horse or sulky plow used with revolving coulter attached.

HOT-BEDS AND COLD FRAMES.

Not even as far north as Norfolk is "glass" used by truck farmers for the regular "forcing" of vegetables. The object aimed at is merely to protect young plants from cold and inclement weather until the season arrives for committing them safely to the open ground. The climate at Norfolk is too severe to admit of the general use of cold frames for tender plants, while south of Savannah bottom heat is never necessary, and in this latitude only when a very light, warm, sandy soil, and a protected locality is not available. During an experience of twenty-nine years I have never had to resort to hot-beds for the preservation of tender plants, as tomatoes, egg-plants, &c., never having lost a whole bed by cold. More careful attention, sound glass, well-fitting sashes, and tight frames are, however, indispensable, when cold frames in lieu of hot-beds are used, but the plants are of more stocky growth. On a colder clay, or even a light loam, slight bottom heat is necessary to carry tender plants through the winter months. In the warmer climate of Florida both may be dispensed with, occasionally a slight screen of any kind only being required.

Evaporation and radiation of heat into space at night are the means of preventing the accumulation of the heat of the sun upon the earth, or all life would soon be extinct. When radiation of heat at night cools the surface of the earth to a lower degree than the surrounding air, its moisture is condensed in the form of dew. If the cooling of an object

roceeds sufficiently to congeal the particles of condensed water into rystals of ice, we have white or hoar frost, which cannot occur in this ıtitude unless the thermometer falls as low as 44°. This deposition f the vapor of water from the air is of vast importance to vegetation 'hen precipitated upon its foliage or imbibed by the hygroscopic ower of the well-tilled soil. If a screen is interposed between the sky nd the surface of the earth the partial prevention of cooling of an bject near the ground is due to the reflection of heat by the lower sur- ıce of the screen back to the object. The gardener avails himself of his in various ways to screen his tender plants against injury from ost. None can occur on a cloudy night, because the clouds act as creens and reflect back a portion of the heat they receive by radiation. 'he nearer the clouds the greater the protection. Clouds of smoke may e utilized upon the same principle. When a body is exposed on a lear night its cooling will partially depend upon its contact with bod- es warmer than itself, from which it receives heat by conduction. Bodies thus exposed will naturally radiate heat in a windy night as in calm one, but the motion of the warmer air, however slight, conveys o them sufficient heat by conduction to prevent the deposition of dew r frost.

In freezing or anticipated freezing weather, the sash must be put on ong enough before sunset to warm the soil and confine a quantity of eated air within the frames; but even then the screen of glass will ften not be sufficient to protect even as hardy plants as cauliflower in old frames, particularly during clear, moon-lit nights. In such cases n opaque covering for the glass, as board shutters, mats, or old carpet- ng, will be necessary completely to protect against the effects of radia- ion. At favorable locations to procure them the spreading leaves of he large palmetto will be sufficient, or pine straw may be utilized.

A certain degree of watchful care is necessary to the management of lants under lass, for, be it understood, that is not only in the end the est but the cheapest material for covering hot-beds and cold frames. Should a substitute in any case be desired, common cotton cloth ren- lered more translucent by means of the following ingredients may be ısed: 1 quart pale linseed oil, 4 ounces rosin, 1 ounce sugar of lead. A ittle of the oil and the sugar of lead should be ground together, then he remainder of oil and the rosin melted together be added, and the nixture applied warm with a wide brush]. To produce plants of a vig- orous, healthy, stocky growth is the object aimed at. Too much light ınd heat will produce a useless spindling growth; too much moisture ınd heat a luxuriant sappy growth, readily succumbing to cold, and rom too much moisture and deficient light the plants are apt to damp off. It is necessary to study the effects of these agents upon plants in ıot-beds and cold frames, in order that the truck farmer may apply them n harmonizing proportions towards the production of a sturdy vegeta- ion. It must, however, be constantly borne in mind that retardation ather than accelleration of growth is the object in view, and therefore he glass should only be used for purposes of protection from cold and oo much rain.

Plants should never be allowed to crowd each other under glass to he injury of all. As rarely any two kinds of vegetables require the ne management, different species should not be planted in the same or bed.

r ring secured a supply of good plants, it is the best policy of the essive farmer to transfer them to the open ground as early as the n admits, but, after being transplanted, it will hardly ever pay the

truck farmer operating on an extensive scale to attempt protecting them from frosts subsequently. He should, however, never fail to hold a sufficiency of good plants in reserve to supply any losses or to reset the whole crop if necessary.

It is advisable that the truck farmer should make a study of the phenomena of atmospheric changes, particularly at a distance from cities, to guide him in the management of his hot-beds and in the putting out of his plants judiciously. The recent regulation of the United States Signal Service ordering the hoisting of a cold-wave flag at the station upon an expected decrease of temperature will be of great service to truck farmers near the cities. In this latitude upon the Atlantic coast a rapid fall of temperature may be expected in winter and early spring when, after a warm rain, the weather clears with the wind from the northwest. A clear streak in the northwestern sky near the horizon indicates the coming change. The fall of temperature under such circumstances is sometimes very great. Thus, after a warm rain at 1 p. m., April 3, 1879, the thermometer stood here (Wilmington Island) at 75°, but it fell during the night ensuing 36°, giving us a killing frost on the morning of the 4th with the mercury at 39°.

PACKING AND MARKETING.

If fruit and vegetables, although somewhat inferior in quality, are put up for shipment in clean, bright, and carefully constructed packages, presenting to the buyer an attractive appearance, they are very apt to command better prices in the Northern markets than a better quality in less inviting packages. Prime quality, then, together with a bright presentation of packages will be certain, under other favorable circumstances, to secure the most gratifying returns. In proof of the importance of neatness and quality I may mention the fact that during the month of July, when tomatoes have long been in season from Florida, Georgia, and from Norfolk, together depressing and nearly glutting the markets, so-called one-third bushel crates (capacity in the clear 820 cubic inches, dimensions of heads 5 by 8, laths 22 inches) from Chicago have sold in the Northern markets at $1.25, while Norfolk bushel crates were quoted at from 50 cents to $1 per crate. The difference is the more striking when it is remembered that Chicago is more than twice the distance from the places of sale than Norfolk. The better price is, therefore, not attributable to fresher condition, but solely to selection and careful packing in regular layers, and to the use of bright, small packages. The careful truck farmer, desiring his mark to be favorably known in market so as to insure a sale of his produce in preference to that of his less painstaking competitor, should be careful, therefore, to put up none of inferior quality or unsoundness. The very slightest speck is frequently an evidence of commencing decay or overripeness, and should condemn the fruit or vegetable. A barely perceptible taint to the packer at home will probably, three or four days later, become an odious blemish to the purchaser. A single rotting vegetable may infect others and reduce or ruin the value of the whole package.

If vegetables of second quality, referring to size and not to soundness, are supposed to be worth more in market than at home, then the "culls" or "seconds" should by all means be shipped in separate packages. If packed together the inferior will detract from the market value of the first grade.

The matter next in importance is so to fill the crate or barrel that it may arrive in presence of the buyer as near full as the shrinkage of the

cial vegetable will admit of. It is impossible, for instance, so to fill ate with beans as to be full at destination. It should, however, be ne in mind by the grower that these buyers cannot be imposed upon dily. They are too experienced not to see at a glance what degree emptiness to attribute to natural shrinkage and what to careless king. If crates or barrels are filled in a heedless, neglectful manner, tily nailed up, and hurriedly dispatched, the probabilities are that urns will be unsatisfactory. If vacant spaces are left between the tents, they will be filled by the shaking down in transit. Articles too small to be handled singly should be packed so carefully as to be ject to very little settling. The only vegetables at present generally wn for the Northern markets which may be dumped into the packs and thoroughly shaken down for shipment are beans, onions, peas, l potatoes. Cucumbers are frequently so treated, but not with propety. Whatever the vegetable, the contents of the package should so ge up beyond its level as to require some force to press on the head cover. A slight bruising of the upper layer is of no importance when entire contents are protected from abrasion by the close packing. e pernicious practice of "deaconing," "topping," or placing in the per layer articles of better quality, and in the lower of inferior should discountenanced by the trade. It is unfortunately too much done, hile neither more nor less than an attempt to swindle. If every one ho ships a package so filled would consider that his mark becomes a flection on his honesty, he would shun the practice, eventuating in s own benefit, for the mark would then become known and sought in arket.

For purposes of ventilation the laths of a crate should be as far apart the size and character of the special vegetable will admit of without nger of its being cut or indented by the edges of the laths. With the me purpose in view holes should be cut both in the head and sides of rrels, and none but clean, sound, round-hooped ones should be used. ch vegetables only as are sold by count, as radishes per bunch, for stance, may be packed in larger sugar barrels or the smaller flatoped "pony" barrels. Crates should in all cases be constructed with center piece to secure stability, dividing them into two equal parts. e dimensions of the head and center pieces are 8 inches by 14 inches d the length of the laths 2 feet. Unless their width is suited to the rticular vegetable to be packed it may become troublesome to arrange proper width of the interspaces. For tomatoes and cucumbers they ould be fully 2 inches wide. If rectangular packages were put up in rge piles on shipboard there could be no access of air to all. For purses of ventilation, then, the corners of end and center pieces are cut f, giving them an octagonal shape. The corners should be about half inch wider than the laths in order to admit air when piled. The corers are not removed in barrel crates, the dimensions of these being 11 20 by 36 inches. If the crate is to be shaken down two or three laths e loosely placed over the bulging contents and the packer, grasping ch end together with the laths to prevent jolting out, lifts them alterately, allowing each to come to the floor with a sudden thump, and is process is repeated until the contents are thoroughly settled. The ckages should be plainly and neatly marked on each end, all old ands on second-hand barrels having been completely removed with scraper. Sappy pine makes a lighter crate than heart wood; but made of unseasoned lumber the bundles should be opened and the ths aired and dried to prevent the highly objectionable molding which herwise ensues.

After having succeeded in producing a good crop it is as important to market it with judgment. An article may command a much better price at one place than at another. This difference even applies to varieties of the same vegetable. It is therefore advisable to learn the peculiarities of each market. While the red variety of the sweet potato sometimes brings a fair price in Boston it will hardly pay to ship any other variety than the yellow Delaware, or Nansemond, to New York. There is little difference between the two in Boston, while in New York the white onion sells better than the red. While of all the Eastern markets New York, not only in consequence of its own large population and of that of adjacent important cities, but also in consequence of its being a center of more general distribution into the interior, will always receive the bulk of the truck crops, shipments to other markets often bring better returns. Thus Boston and Baltimore are better markets for choice tomatoes than New York or Philadelphia; Boston better for melons than any other, while Baltimore is the poorest for either cauliflower or watermelons.

Nearly all the truck grown along the Atlantic coast convenient to ports having adequate steamship communications with the North is marketed by sea in the Eastern cities, Baltimore, Philadelphia, New York, and Boston; a small portion of the Norfolk crop only going to Providence by sea, to Washington by the Potomac River, and to the interior by the Cheasapeake and Ohio Railroad.

As points of production become more distant from the ports, consignments are divided, a portion coming to them from Florida and the counties of Clinch, Lowndes, Brooks, and Thomas, in Georgia, on the line of the Savannah, Florida and Western Railroad to be forwarded eastward, while the other part, together with the productions of the southwestern counties, is sent westward by the various diverging railroads. A part of the Florida crop goes by sea from Jacksonville to New York, the only steamship connection direct. The Mobile truck farmers are confined to the Western markets, principally of Nashville, Louisville, Indianapolis, Saint Louis, Cincinnati, and Chicago, where their shipments come, very much to their detriment and to the future prospects of Mobile truck farming, into competition with the earlier Florida crops. A very small part is there shipped by river boats to supply local interior trade. This interior domestic trade, as in Georgia and South Carolina with cabbage and melons, is generally limited to a few articles.

Norfolk enjoys the best transportation facilities:

(1) The Old Dominion Steamship Company dispatches a steamer daily to New York, Fridays excepted, making the run in from twenty-two to twenty-eight hours, and it occurs perhaps half a dozen times in the season that two steamers depart the same day, even then leaving freight on the wharves.

(2) The Boston Line, tri-weekly to Boston.

(3) The Clyde Line, tri-weekly to Philadelphia.

(4) The Baltimore Steam Packet Company, daily to Baltimore.

(5) The Potomac Steamboat Company and the People's Line, tri-weekly to Washington.

(6) The Providence Line.

(7) New York, Philadelphia and Norfolk Railroad.

(8) Chesapeake and Ohio Railroad to the West.

At Charleston the steamships of the Baltimore Line were withdrawn during the season of 1884–'85.

At present the Clyde Line has one ship, and the Adger Line two steam-

:s, making between them departures weekly for New York and weekly) Philadelphia by the Clyde Philadelphia Line. A new line to Baltiore is, however, contemplated.

Although larger acreages are planted in truck in the vicinity of harleston than in that of Savannah, the latter has the advantage in :ansportation facilities.

(1) The Ocean Steamship Company has a tri-weekly service to New 'ork with the finest steamships of the Atlantic coast, and under the ıanagement of the able agent, General G. M. Sorrel, the manner of andling and caring for produce has improved.

(2) The Boston and Savannah Steamship Company, a weekly, with ne ships like former.

(3) The Ocean Steamship Company, a weekly to Philadelphia.

(4) The Merchants and Miners' Transportation Company, also a bi-'eekly service to Baltimore.

The two Charleston and New York lines with three steamers between ıem have a bi-weekly service to New York, and the Clyde Philadelhia Line dispatches one steamer weekly.

SEED.

The quality of seed is of more importance in market gardening and uck farming than in any other branch of agriculture. Should they ıil to germinate, a loss of a couple of weeks might be fatal to the prosects of the entire crop, the produce being comparatively worthless un-ss placed upon the market at the proper time. No such dangerous ısualty applies to grain or cotton planting. Again, if the seed do not rove true to variety, the same contingency obtains for an unpopular ariety will meet with very poor sale. Hence the importance of the uck farmer's procuring his seeds from the most reliable sources. Poor ne are dear at any price! He can better afford to pay treble the rice for those which from experience he knows to be good, than to exeriment with cheaper, for half the success of his crop will depend pon the seed he uses. In my experience I have found a considerable ifference in the trustworthiness of some of the most extensive seed deal-rs. It is the best policy for the truck farmer to save his own seed, hen possible, but our Southern climate is not favorable to the quality f some home-grown seed. Thus cabbages, cauliflowers, beets, carrots, rnips, &c., and a few others, natives of cold climates, would, even he first season, be inferior when produced from Southern seed; but here is no reason why the Southerner should not use his own seed of ucumbers, egg-plants, onions, melons, squashes, peppers, and tomatoes, eing plants indigenous to southern climates.

If there be the slightest doubt in reference to the freshness of seed he safest course is to make a preliminary test of their vitality. Dr. oble, of the Tharandt Seed Central Experiment Station, Germany, has evised an apparatus of porous earthenware for this purpose; and there e several others in use in the United States. To test seed, I place a ample, wrapped in moist cloth or blotting-paper, in the bottom of a nall empty flower-pot, which is plunged in the soil of a larger one; a ird, full of moist soil, of the size of the first is set in that upon the par-l, thus surrounding it with moisture. The sample can be readily exmined and the percentage of sound seed easily ascertained.

There is considerable difference of opinion among experimenters in gard to the duration of vitality in agricultural seeds. It depends robably upon different climatic influences.

Below is a table showing the earlier experiments of Cobbett, in England, and the later ones of Vilmorin, in France.

Seed.	Cobbett.	Vilmorin.	Seed.	Cobbett.	Vilmorin.
	Years.	Years.		Years.	Years.
Artichokes	3	5	Leek	2	2
Asparagus	4	4	Lettuce	3	5
Bean	2	6	Melon	10	5
Beet	10	5	Onion	2	2
Broccoli	4	5	Okra	2	.....
Cabbage	4	5	Pea	2	4
Carrot	1	4	Pumpkin	10	5
Cauliflower	4	5	Radish	4	5
Celery	10	.....	Salsify	2	2
Corn	3	2	Spinach	4	5
Cucumber	10	5	Squash	10	5
Egg-plant	3	.....	Tomato	2	.....
Endive	4	0	Turnip	4	5
Kale	4	5			

It will be seen that, with the exception of the beet and the cucurbitaceæ, the French table ascribes a longer vitality to nearly all the varieties. Southern vegetable growers will bear in mind that our warmer climate, and particularly the moist air on the coast, might affect longevity of these seeds differently. Beans, peas, and onion seed cannot be relied on after the first year. Cabbage and turnip, if carefully preserved, may be used the second, and those of the cucurbitaceæ up to the fourth. Experience teaches us that fresh seeds of cucumber and the other plants of that family are apt to run more to vine, while those a year or two old will be productive. As a rule, however, it is safest to procure fresh seed.

Old seeds, being endowed with weaker vitality, are used by florists to produce double-flowering plants. For this reason fresh tomato seed should only be used, because the double flowers form ill-shapen, knobby fruit, while the single flowers bear the desirable round fruit.

The degree of heat necessary to start vital action varies in different species, which is important in germinating seed under glass. Seeds of plants indigenous to warm climates will require a higher degree than those of a colder one. The most favorable temperature of the soil for the germination of seeds of plants from cold climates is from 50° to 55°, those of green-house plants from 60° to 65°, and those from the torrid zone from 70° to 80°. Of all the seed sown by the truck farmer those of the onion will germinate at the lowest temperature, only a few degrees above freezing being sufficient, and they may therefore be sown in winter in the open ground. Those of the melon and egg-plant require the highest degree of heat.

No safe rule as to depth of sowing seed can be established, as both the soil and the weather must be considered. During the period of germination the latter may change from one extreme to the other. If moderately moist weather could be assured, the rule might be depended upon to cover them to the depth of their own thickness. Ordinarily this would be much too shallow. In a light, sandy soil they should be placed deeper than in a tenacious or loamy one. If seed absorb more moisture than they can decompose they rot; therefore wet ground makes an improper seed bed. On sandy soil, after a rain following a severe drought merely moistening the surface, they should not be sown, for if no further rain ensues they may perish after having germinated, the young root not finding enough moisture for its support.

With the exception of those of radishes for a crop, no seed of the truck farmer should be sown broadcast. Drill-sowing, either by hand or machine, is much to be preferred, as the seed may be deposited more

gularly at uniform depth, and the young plants may be more con
ntly thinned, weeded, and worked, if necessary; besides the op
ion may be performed during the prevalence of a wind with the
hine.

PROFITS.

Truck farming is perhaps more than any other branch of husban
ubject to those vicissitudes and casualties which cannot be guar
gainst by any human care, foresight, or knowledge. It is carried
ver such an extensive area at present, the different acreages of its cr
ave been so enlarged, vastly augmenting the production of recent ye
hile the number and the demand of the markets have been propor
tely very slightly increased, that the profits during the last two seas
ave been consideraly reduced. The most unfavorable contingen
eem to have combined during this period to depress the indus
These influences, however, have nearly all been of temporary chara
nd, with the returning smiles of fortune, it will again revive. Un
rdinary circumstances thoroughly competent truck farmers, favora
ocated and otherwise fully equipped with the essential elements of s
ess, will render it, even under the existing drawbacks, one of the m
ucrative branches of agriculture. But when they fail their los
re proportionately heavy. If one or more of his crops be killed
rost, it being too late to replant, the entire expenditure of mo
nd attention is a total loss; thus one of the most extensive farm
ost his bean crop, involving a loss of $1,200 in expenditure. No
with the local Northern market gardener, who, even if he should be a
le late, has the entire season before him. Before truck farming had
ended to Florida the bulk of the different crops from the vicinity
Savannah and Charleston would be marketed before the same arti
could come into competition with them from Norfolk. Under a b
narket, prices would occasionally rule very high for a favorite veg
le. Thus a couple of crates of tomatoes sold ten years ago, on 7th Ju
n Baltimore, at $16 each, and larger shipments frequently brought
nd $10 per crate. At present Florida could keep the markets supp
rom January to August, when those of Northern home production
ure. Her shipments, together with the fine quality of canned goo
ave affected the price to such a degree that, at the same season,
alue of Savannah-grown tomatoes hardly ever reaches $4 per crate
eing considered a fair price. These influences affect the prospect
Norfolk so seriously that the acreage in tomatoes will be considera
educed the coming season. Competition of California cabbages w
hose of Gulf production in the Northwestern markets has, in the
wo years, had the same effect upon the cabbage crop at Mobile.

The point where the industry may be pursued with the greatest pr
seems to have receded with its growth. Although Florida prod
omes partially into competition with that from Bermuda in the ea
narkets, and is subject to loss and damage commensurate with the grea
listance of transportation, if current reports are to be credited,
truck crops command the most money; yet I have heard Northern c
mission men say they were disinclined to handle some of the varietie
vegetables shipped from Florida in consequence of their too freque
objectionable condition. The cost of a thoroughly prepared truck c
about 2 miles from a city, estimated up to the time of harvest, includ
all the varieties usually grown (except asparagus, which is more
pensive and more remunerative) averages about $125 per acre, a
during a favorable season, a good truck farmer ought to net, clear of
expenses, $100 per acre for the total area under cultivation.

Whatever may have been the discouraging effects of the last two seasons of failure, the successes of the preceding years have created such a demand for favorable locations in the vicinity of the coast cities as to enhance the value of land very materially; thus such land in the neighborhood of Savannah has increased within the last fourteen years 150 per cent. in value.

As an evidence of the effect of season upon the success of truck farming I may here mention that, while for the last two wet years it hardly paid the labor to pick egg-plants, a farmer near Savannah netted in New York $600, in 1882, from the crop of 1½ acres.

CAUSES OF FAILURE AND IMPEDIMENTS TO GENERAL SUCCESS.

In no profession, industry, or calling is success so often dependent upon contingencies entirely beyond the control of its votaries as in agriculture, and, in consequence of the perishable nature of its produce, this applies with greatest force to truck farming, because they have to be marketed at a distance from the place of growth. This necessity involves all the vicissitudes and dangers incident to delay and transportation. The very unfavorable seasons of the two past years were the only providential causes, and against the changes and injuries of the weather the competent farmer can only pit a determination to reap a profit when next he may be blessed with a fairer season. Unfavorable weather may not only very materially diminish the total yield, but, more disastrous still to the prospects of the truck farmer, it may endow his produce with a nature so unstable as entirely to destroy its carrying capacity. This is exactly what occurred during the last two crop years. The very wet weather prevailing nearly over the entire South during the growth and maturity of the vegetables, so filled them with superabundant moisture as to impart to them a tendency to decay, and most of such shipments arrived in bad order.

Other circumstances being favorable, so long as stock, generally, of good quality is placed upon the Northern markets sales are apt to be satisfactory, but as soon as inferior stuff is thrown upon them, prices suddenly fall on all alike, hardly ever to revive during the entire season. The disastrous effects of these so to say water-logged and readily decaying shipments upon the market may then be readily appreciated.

In enumerating the causes of failure I am confining myself strictly to truck farming as an industry. While believing that a few favorably located cotton planters, possessing the necessary degree of experience, judgment, and carefulness, might have made money with certain vegetables during a favorable season, I only allude here to their failures in experimental truck farming by stating that the general quality of their shipments, inferior in every respect, was one of the chief causes of the common result. Good quality being essential to success, no satisfactory returns could reasonably have been expected from a crop of Irish potatoes manured with 200 pounds guano per acre, for instance, and probably on poor land at that. The farmer gathered of all sizes and qualities 50 barrels from 7 acres, or 7.1 barrels per acre, while with adequate manuring from 60 to 100 barrels is the satisfactory yield per acre of merchantable stock. In another case a farmer reported that he had shipped 30 crates of green apples "because his hogs wouldn't eat them."

Failure was then only attributable to overproduction as applied to superabundance of stock of inferior quality.

Among all the difficulties and drawbacks appertaining to truck farming, perhaps the one which most frequently has been considered to bear with greatest weight upon the industry is the unreliability and dishonesty of commission men. With what degree of justice the charge is

nade it is difficult to say. Heavy and manifold losses have no d
ccurred through the rascality of commission firms. It being im
ible to restrain or supervise their operations villainy has a fair fiel
Truckers should beware of those who send out circulars of cur
rices above the market rates. They report a small sale or two
ate higher than actually received, and then make the shortage goc
oon as they have gained the confidence of the shipper by repor
ales at a lower figure than the produce actually sold for. I have
nown otherwise reputable houses to resort to this sharp practic
ecure shipments. The business standing and credit of a particular
s ascertainable through a mercantile agency, but such an agency fai
mpart the desired information to the vegetable shipper. It would, l
ver, be rank injustice to make a sweeping charge of swindling aga
he entire class of produce commission agents. While it doubtless
ains its proportion of sharpers there are numerous responsible firm
very market who aim to build up an increasing business and a sc
eputation by honesty and fair dealing with their shippers, and
rown upon the disreputable members of their own calling. T
eliable firms should be supported, not only by exclusive consignme
ut by the good will and frequent recommendations of their fri
t the South.

It is noticeable, too, that specific charges of having been swin
ccur most frequently in unfavorable seasons, when goods of infe
uality are forwarded—a coincidence which suggests that the cha
re probably unwarranted. No buyer in any Northern market i
haritably disposed towards the seller as to pay a good round price
n article fit neither for the food of man nor beast.

These accusations do not usually emanate from experienced and p
ical truck farmers, but from men carrying on the business either
obby or as a secondary matter, who have others to superintend it
ess experienced than themselves.

Another drawback consists in the many difficulties of transportat
Since 1858, when shipments of melons had to be intrusted to the cust
f the captains and pursers of the steamships to secure their protec
gainst stealage, for which, together with attending to their sale in
York, they received 50 per cent. commission, great improvements h
een made in transportation. Only a few years ago the losses on
ns by robbery was very considerable. The interests of the growers
he conveyors to market seeming identical, it is probable that in the
uture the various transportation companies may see the wisdom of
ouraging an industry which helps to support them. It is princip
he melon industry, as a branch of truck farming, which has to comp
ot so much against the quality as against the freight rates of trans
ation. The former has much improved within the last few years.
irst common box-cars were used, and where the melons were piled l
alt would sometimes be left upon the floors. Now well ventilated, s
nd clean fruit cars have been constructed in sufficient numbers
ressly to move the enormously increased melon crop. But the m
growers on the line of railroads complain that unless the present
f freight to the West be reduced they will be compelled to abandon
ndustry. Truck farmers protest against all adverse discriminatio
he matter of freight rates. The average intelligence of the Alab
growers at Mobile is unable to understand with what degree of fair
heir 38,363 barrels of potatoes are made to pay nearly double the fre
rom Mobile to the West that the Western farmer would have to
rom the West to Mobile for the same number of barrels.

The steamship companies at Savannah have established two different rates of freight. Those shippers who sign contracts with the companies not to sue for damage to produce, unless due to culpable and proven negligence, are favored with a lower rate, as below:

Shippers—	To New York, Philadelphia, and Boston.		To Baltimore.	
	Barrels.	Crates.	Barrels.	Crates.
	Cents.	*Cents.*	*Cents.*	*Cents.*
Under contract	50	25	40	20
Not under contract	75	35	75	35

The freight on a barrel of potatoes from New York to Savannah, however, is only 30 cents, so that the favored shippers are charged 20 cents more on each barrel of potatoes from Savannah to New York, &c., than the Northern farmer pays for the same transportation back. The aggregate number of barrels (51,065) paid, therefore, $10,213 more than the same number would have to pay from the North to Savannah. This discrimination may well be considered a drawback to truck farming.

The industry demands most excellent judgment and foresight, and it is an error to suppose that any one competent to till the soil can jump into truck farming and make a success of the venture. I have in mind three men, A, B, and C, who operated nearly in sight of each other's farms. A commenced a few years ago, about the same time as B, with a borrowed capital of $1,000, on rented land adjoining that owned by the latter. A and two brothers now possess in fee-simple, besides other property, 275 acres of this land, the best for truck farming in Chatham County, a part of which they rent out at $25 per acre per annum, and 10 acres of which, with a river frontage, they lately sold for $8,000. B, in consequence of non-success, has sold his place to C, the most competent of the three, who had until recently been managing a larger place on shares. At another center of truck farming one man, a handicraftsman, commenced truck farming with a single very inferior draft-animal, a steer. He now owns and supervises five farms, having bought out others not so successful as himself, one of them also having been a truck farmer.

AMOUNT OF TRUCK SHIPPED.

It has been impossible to procure correct and complete statistics of the amount of truck shipped during the last two crop seasons. Below will be found partial statistics from only a few points of shipment. The tables do not include any shipments from Wilmington or New Berne, N. C., from points on the coast to Charleston, from Port Royal, S. C., or from Jacksonville by sea direct. They are also exclusive of a part of the Florida consignments by land, and those from South and Southwest Georgia, from New Orleans, and from Galveston.

CHARLESTON.

The following table exhibits the shipments of strawberries, vegetables, and melons by rail and by steamer during the past three years:

Truck.	1885.	1884.	1883.
Berries.....quarts..	669,566	450,680	708,476
Potatoes.....barrels..	60,000	45,349	51,490
Vegetables.....packages..	90,530	62,333	81,332
Melons.....	500,000	.....	.....

The following is an estimate of the value of the fruit and vegetable crops of Charleston during the past year:

Truck.	Amount.
Strawberries, early crop	$200,000
Potatoes	350,000
Melons	75,000
Miscellaneous fruits and vegetables	350,000
Total	975,000

The strawberry crop came so late into market in consequence of the frequent severe spring frosts, that Charleston berries were crowded out by arrivals from Norfolk, leaving thousands of quarts to rot unpicked in the fields, otherwise it was estimated the shipments would have reached 1,200,000 quarts.

Savannah by steamships.

Shipped by—	1884.	1885.	From Sept. 1, 1884, to Sept. 1, 1885.
Ocean Steamship Company to New York and Philadelphia:			
Crates	202,060	237,317	.....
Barrels	29,208	41,486	.....
Melons	353,379	457,687	.....
Boston Line:			
Vegetables:			
Crates	.....	.....	20,836
Barrels	.....	.....	3,345
Fruit:			
Crates	.....	.....	60,146
Barrels	.....	.....	534
Melons	.....	.....	295,847
Baltimore Line:			
Crates	35,827	21,473	.....
Barrels	8,424	6,283	.....
Melons	.....	150,000	.....
Over the Western and Atlantic Railroad:			
Melons.....car-loads	.....	1,146	.....

MOBILE.

Truck.	1884.		[redacted]	
	Shipments.	Value.	Shipments.	Value.
Cabbages.....crates	10,212	$43,401 00	18,210	$40,052 00
Potatoes.....barrels	34,704	69,048 00	38,363	57,544 50
Beans.....crates	35,584	26,050 50	18,900	11,280 00
Peas.....do	18,062	13,062 00	11,071	8,303 25
Turnips.....do	1,178	1,767 00	155	194 00
Cucumbers.....barrels	929	2,552 00	168	336 00
Tomatoes.....crates	40,053	16,020 80	6,833	4,099 75
Watermelons	20,651	8,097 65	6,770	1,015 50
Various packages	976	2,934 00	285	612 00
Total packages	167,299	178,582 95	100,835	124,237 00

ASPARAGUS.

The supply of this early and delicate vegetable has never been sufficient to reduce the market value below a good paying price, and were it

not for several drawbacks it would be cultivated much more extensively. The crop yields no return under four years from the seed, and even then should be very sparingly cut for a year or two. It requires heavy manuring to prepare a good planting, and, as it lasts without renewal twenty or more years, its cultivation should be carefully undertaken. The plants being more costly, as generally procured, the preparation is more expensive than that of any other crop. It comes in so early in the spring that previous to maturity the field requires no cultivation for the purpose of subduing weeds, the consequence being that during the busiest season of gathering other crops for market this one is neglected, unless, as done by large growers, a special manager is appointed to look after it. I have known more than one farmer have to plow up his asparagus in consequence of this culpable neglect. To save the expense of plants, therefore, for economic as well as for obvious horticultural reasons, the Southern planter should himself raise all he needs from the seed. The usual price of seed is about 50 cents per pound, and as there are about 14,000 seeds in each pound, he should be able at least to secure 10,500 fresher, sounder, and better plants for 3 acres than he can procure from a distance for about $21 at the usual lowest rate of Northern nurseries of from $4 to $8 per 1,000.

Asparagus being a diœcious plant (bearing pistillate and staminate flowers on separate roots) it is doubtful whether it has the numerous varieties offered by the seed trade. Certain it is, however, under whatever name the seeds may be advertised, if properly manured, planted, and subsequently cultivated and cared for, the income from the crop will be alike satisfactory to the grower.

The roots of asparagus cannot be injured in the ground by cold, and as the seed germinates at a low temperature, they may be sown from December 1 to March, in drills 1½ to 2 feet apart, and—if superior plants are desired—so thinly that they may stand about 3 inches apart in the rows. At this distance one-fourth acre of seed-beds will supply plants enough for from 5 to 7 acres. Fair plants, however, may be grown on the same area, standing nearer, for 12 acres.

One of the chief claims of asparagus to popular favor is its earliness. It should, therefore, be planted on deep, dry, warm soil to have it early, and because such a one suits its growth best. When located near its natural habitat, the sea-coast, it grows most satisfactorily. The more manure and the more careful the cultivation the better the "grass," as the shoots are designated in market. The rows in field culture should be 5 feet apart, the plants standing at least 2½ feet apart, requiring 3,484 plants per acre.

The deeper the plants can be placed, due regard being had to the requisite of early growth, the less risk will there be of the crowns being injured by the knives in the hands of careless cutters, 4 to 6 inches being the usual depth. If the crop has been properly planted, and is as frequently cultivated and hoed as required to subdue grass and weeds, the luxuriant growth will meet across the rows and shade the ground the third season. Asparagus produces seed the second year. As soon as the stalks commence to die in the fall they should be cut down and burnt to prevent, as far as possible, the growth of volunteer seedlings.

As a special fertilizer salt may be annually used as a top-dressing in sufficient quantity partially to prevent the growth of weeds, say, 800 pounds to the acre.

Only the tender part of the shoots made green by exposure to light is eaten, yet fashion and the trade demand that a part be white and tough.

When they are from 4 to 6 inches above ground they should be cut by assing the edge of the knife drawn along the shoot and severing far nough below the surface to make the bunches after trimming 8 inches ng. A plantation in full bearing may be cut daily, but not longer than bout four weeks for fear of weakening the plants. The bunches should be ompactly made of assorted "grass," (with the help of an asparagus uncher), 4 inches in diameter, 8 inches long, squarely trimmed, weighg 2½ pounds each, and tied firmly with bast or raffia near the crowns nd again near the bases. Uniformity of packages is desirable, but as is sold by the bunch, it may be put up in other than the usual bushel rate. The bunches should all be placed upright, and if in more than ne layer, the buds of the lower should be protected by some soft intervening material like moss.

The first arriving in New York sells for about $12 per dozen, but soon rops to $9, to $6, and lower.

The original cost of a planting with home-grown plants is $100 per cre.

To save seed the stalks should be cut when the former are scarlet and ipe, to be stripped by hand or threshed off on a cloth or floor, then ounded in a wooden mortar with a wooden pestle to break the outer hells. The seeds are then frequently washed to float away the chaff, ried in the sun and air and stored. Asparagus is subject to injury rom the following insects: (1) The Asparagus Beetle (*Crioceris asparagi*), 2) the Zebra Caterpillar (*Mamestra picta*), and (3) the Smeared Dagger *Acronycta oblinita*). The former has been very destructive at the North, articularly on Long Island. It has not *yet* reached Georgia, nor are he other two insects very injurious.

THE BEAN—BUSH OR SNAP (*Phaseolus vulgaris*).

The bean, a tender annual, a native of India, can be grown to maturity in so short a time from the sowing of the seed, six weeks, and it is o generally popular at the North that in the neighborhood of the ities it is one of the most important vegetables of the truck farmer.

The flat podded Early Mohawk is the hardiest and earliest variety, ut it only sells well before the more popular, more tender, and less tringy round kinds come into market, of which the Early Valentine nd Extra Early Valentine are the favorites.

The several varieties of German Wax-beans are fine and command the est prices when of good quality, but they become spotted more readily nd are not as extensively grown as the others.

This vegetable is so tender that no time can be given definitely for lanting it. For the latitude of Savannah, according to season, approxiately from the 20th February to the middle of March; later to the orthward and earlier to the southward. In the south of Florida it may e safe to plant at any time in the winter and in the middle of the State early as January 10. Formerly vegetables regarded as out of season ould be nearly unsalable, but now beans sell in limited quantities as ly as March, bringing fair prices at the North.

A sandy loam suits it best, but the lightest land of the farm may be ppropriated to the bean crop, and green or fresh stable manure is better adapted to it than to any other vegetable.

Straight furrows having been laid off 2½ feet apart on land previously ell prepared by plow and harrow, the manure is drilled in at the rate of n-loads of about 30 bushels each and covered by the plows. The

ridges are then partly leveled by means of a board attached to a plow beam, taking two at a time, or by hoe or rake. To avoid repetition (when manuring in the drill and planting on ridges are mentioned hereafter), the above operations must be understood to have preceded the sowing of seed or setting of plants.

If a seed drill can be arranged to work accurately and satisfactorily its use is the cheapest and most expeditious method. Otherwise the beans are dropped in an open drill 3 inches apart and covered about 1½ inches deep.

The cultivator may be run between the rows when the plants are 3 or 4 inches high, and just before the buds appear the plow and hoe should be used to land up, or draw soil to the stems.

The pods should be picked while yet tender enough to "sugh" before the seed commence to bulge, and the operation should be performed with as little disturbance to the roots as possible.

Beans are more liable to shrink than any other vegetable and a little wilting prior to packing is not objectionable. They should be laid as regularly as possible without too much loss of time, and thoroughly shaken down and firmly packed. About six pickings are made in the three weeks of the crop.

A fair yield is 150 crates, and prices range from $1 to $4 per crate, according to demand and earliness. The returns from beans was very poor last season, a part of the crop not being worth the picking.

The insects depredating upon the bean plant do not affect the truck farmer to any extent, except the Bean-weevil, which sometimes destroys the seed germ.

They are as follows: (1) The Bean-weevil (*Bruchus fabæ*); (2) the Yellow Bear Caterpillar (*Spilosoma virginica*); (3) the Fall Web-worm (*Hyphantria textor*), and (4) the Blister-beetles, striped and ash-colored and the margined (*Lytta vittata*, *L. cinerea*, *L. marginata*).

THE BEET (*Beta vulgaris*).

The beet has not been grown for shipment south of Norfolk to any extent until within the last few years, although a regular Bermuda crop. Of varieties, the Egyptian Turnip is preferred. It can be planted earlier, but about January 1 to 10 is the safest time in the latitude of Savannah. Like all long tap-rooted plants the beet delights in a deep, rich, loose soil. A low, but well-drained mold is best suited to it.

Beets require a nitrogenous fertilizer and about 30 loads to the acre of well-rotted stable manure, or a composted commercial fertilizer of 1,500 pounds to the acre would answer the purpose. As this plant, like asparagus, is a native of the sea-shore, an application of 12 bushels of salt would be beneficial at a distance from the coast.

The seed are sown on ridges 30 to 36 inches apart, in order that the stirring may be done with the cultivator. The plants should be thinned to a stand of 4 to 6 inches and not be allowed to crowd each other. Vacant spaces may be supplied by transplanting. When about 3 inches in diameter they are fully large enough to be shipped. The leaves are cut off about 2 inches from the roots and the beets packed in bushel crates or well-ventilated barrels covered with cloth.

From $2.50 to $3 per crate were the highest prices per crate for Georgia-grown beets the past season.

The beet is remarkably free from all insect depredations.

THE CABBAGE (*Brassica oleracea*).

The cabbage is, both for points near and distant from cities, one of he most important vegetables for the truck farmer.

Of the many varieties of the cabbage family he has to do only with ı few of the white and heading sorts, with the cauliflower, and with :ale, but the cultivation of the latter is confined to Norfolk.

A variety of cabbage to be suited for cultivation at the South for shipnent should be sure to head; to produce medium to large heads they should be so hard and compact as not to shrink much, and should be popular in market. Very large heads are not desirable, not being so vell suited for retail.

The Early Summer, Winnigstadt, and Brunswick are leading varieies. The Jersey Wakefield, but for its liability to burst, although small, vould head the list. Tait's Extra Early is extensively planted at Norfolk. The Flat Dutch is preferred for the local and Western interior vinter trade. European seed are sometimes more sure to head, while American-grown are more hardy. It is of very great importance to nave pure, reliable seed of cabbage and cauliflower. Poor ones are nigh at any price.

Under favorable circumstances cabbages will form merchantable neads in five months from the seed. If stunted by unfavorable weather, :old, or too much rain, by inadequate manuring, poor cultivation, &c., ınd this period becomes materially extended, many of the plants will go o seed instead of heading. The seed should, therefore, not be sown too :arly; if under glass, as the safest plan, between the 1st and 15th of November; if in the open ground, during October. These are liable to ɔe injured by freezes, the plants not being, generally in the South, able o survive a temperature below 24°. To secure a hardy stocky growth he soil of the seed-bed should not be recently manured, if not poor ground, and the glass never put on unless to protect against anticipated reezing weather. The best soil for the cabbage crop is a moist, sandy oam. Any soil well prepared and well manured will, however, produce ı fair crop, unless too dry and sandy, or it may be affected by the hot uns in March and April during the heading season. Lime is very beneficial to the cabbage family, and the shelly lands along the coast and he sea islands are peculiarly well adapted to it.

Cabbages require frequent stirring of the soil, but it should be shalow, so as not to disturb the roots and to stunt the plant. The Northern emand becomes active in March. In preparing the heads for market, or the purpose of protecting them from bruising each other, a few outer eaves should be left and the stems trimmed closely. They should not e allowed to become heated by the sun after being cut, but be packed s cool and as dry as possible. They carry better in crates. If barrels re used they are to be covered with cloth (old grain sacks usually), the ontents bulging about 6 inches above the top of the barrel. Whatever ackage is used considerable force should be applied in order to pack irmly.

A package should contain from eighteen Brunswick to fifty Winnigtadt, and even a greater number of Wakefields. If of good quality otherwise the small heads bring a fair price.

From 170 to 200 barrels or barrel crates is a good crop, and such a ne of good stock *has* averaged in the Northern markets $4 gross per arrel. My own crop of 1882 averaged $4.53, principally in the New ork and Boston markets, but prices ruled very high in that year. The

maximum price for Norfolk cabbage is $3.25 per barrel. Freights were 50 cents per barrel and commissions 7 to 8 per cent.

The cotton crop promising poorly this season, the planters on the South Carolina sea islands have put in an extensive crop of cabbages for shipment. The land being finely adapted to this vegetable, if they have manured liberally and have not put in the seed too early, large yields may be anticipated. No family of plants is more subject than the brassicæ to depredatory insects.

Those to which it is exposed at the South are: (1) The European Rape Butterfly (*Pieris rapæ*); (2) the Southern Cabbage Butterfly (*Pieris protodice*); (3) the Pot-herb Butterfly (*Pieris oleracea*); (4) the Cabbage Plusia (*Plusia brassicæ*); (5) the Cabbage Plutella (*Plutella cruciferarum*); (6) the Cabbage Botys (*Botys repetitalis*), reported first to the Department entomologist by the writer in 1880; (7) the Zebra Caterpillar (*Mamestra picta*); (8) the Cabbage Pionea (*Pionea rimosalis*); (9) the Cabbage Plant-louse (*Aphis brassicæ*); (10) the Harlequin Bug (*Strachia histrionica*); (11) the Wavy-striped Flea-beetle (*Haltica striolata*); (12) the Tarnished Plant-bug (*Capsus oblineatus*); and (13) the False Chinh-bug (*Nysius destructor*).

In common with all other tender plants of the truck farmer it is also subject to cut-worms, the larvæ of night-flying moths, principally of the genus Agrotis. Of those enumerated, numbers 1, 4, 5, and 9 are the most destructive. Healthy, vigorous growth is the best preventive against the latter. The other three may be poisoned by the application of Paris green or London purple, while the plants are yet young, but it is not safe after they commence to head, although during growth all the older leaves are cast off. Other remedies are unavailable in truck farming. Cut-worms may be hunted at the roots of injured plants, or under leaves placed upon the ground. My favorite plan is to poison them before the plants are set out by placing cabbage or turnip leaves on the ground dusted or sprinkled with Paris green, poisoned side next to the soil. Two or three renewals at the rate of a leaf to 20 square feet will generally be effective.

THE CAULIFLOWER (*B. oleracea*, var. *Botrytis*).

If this most delicate and most valuable member of the brassica family would "carry" more safely, at locations suitable for its cultivation, it would be one of the most important crops of the truck farmer. Although so located, I have abandoned its culture, notwithstanding I have netted as high as $24.75 in New York per barrel for it, and the heads or "curd" have sold at a gross average of 37.9 cents each. Sometimes, however, it would continue to arrive in such bad order as not to be worth shipping. For the past two years its culture has been nearly confined to Florida. Coming in so much earlier it is not exposed to heating in transit.

The best varieties are the Extra Early Dwarf Erfurt, the Snow Ball and the very large-growing Algiers.

It should be marketable in March and April, the seed, therefore, should be sown in the latitude of Savannah about December 1, under glass, and transplanted about January 10. A little more manure should be applied than to the cabbage crop, but in other respects the two are to be managed alike. When the curd, however, commences to appear, for the purpose of blanching, it should be covered with a large leaf of the plant to exclude the sun-light.

In packing, each curd should be covered with a piece of soft, smooth paper to avoid bruising, and then laid evenly and snugly in either crate or barrel.

THE CUCUMBER (*Cucumis sativus*).

The cucumber is a vegetable so universally popular at the North, it is so easily grown, carries so safely, and is so productive that, when the bulk of the crop can be shipped, it is one of the best paying crops of the truck farmer. One of the drawbacks of the industry is that whenever the same vegetable matures at a point further north, it comes into market so much fresher and more acceptable to the trade that, whether the entire product be harvested or not, shipments from more distant points are forced out of the market and must cease. This obtains perhaps more frequently with the cucumber than with any other. The season of 1882 was a most fortunate one in this respect. While from 200 to 300 crates is a fair crop, one farmer gathered from 1 acre of richly manured ground the entire product of 900 crates.

The usual variety grown is the White Spine or Improved White Spine.

They may be sown in the latitude of Savannah about the 1st to 15th of March, and earlier or later south or north, respectively. It may go without saying that this applies to the planting of all other crops.

The soil best adapted to the cucumber is a moist, warm, light, sandy loam, but although large crops may not be produced, very fine cucumbers may be grown, if highly fertilized, on sandy soil. In fact no good crop without liberal manuring can be expected from any land, say, 30 loads or more per acre. Instead of the more common manner of hill-planting, leaving two or three plants in each, manuring and seeding in the drill with the ridges 6 feet apart and single plants 12 to 18 inches distant, is to be preferred. Several sowings at weekly intervals are advisable to secure a stand in case the first, or even second, should be injured by frost.

Instead of being pulled the cucumbers should be cut from the vine, and none of imperfect form, short, round, and contracted at one end, nor with the least tendency to turn yellow, nor large and overgrown, should be packed for shipment to endanger the market value of the package. They should be carefully laid in the crates, and these be well filled. The White Spine is white instead of being yellow when ripe. To save the seed they should be cut open lengthwise and the seed and pulp scraped out into a tub or barrel. The mass should be stirred daily for four or five days, when fermentation will have removed the gelatinous substance which surrounds the seeds. These are frequently washed, dried, and stored away in bags.

The insects infesting the cucumber at the South are, (1) the Cucumber Flea-beetle (*Haltica cucumeris*); (2) the Striped Cucumber-beetle (*Diabrotica vittata*); (3) the Twelve-spotted Squash-beetle or Striped-bug (*Diabrotica 12-punctata*); (4) the Pickle-worm (*Phacellura nitidalis*), and (5) the Grass-worm (*Laphrygma frugiperda*).

No. 1 may be driven off, if troublesome, with fresh soot or lime sprinkled on the plants, but it does not destroy them. No. 2 or 3 may be poisoned with Paris green, but it is rarely the truck farmer can resort to these measures, nor is the damage done severe enough to warrant the trouble. The larvæ of Nos. 2 and 3 are sometimes very destructive to the seed in the ground, eating the germ. Seeds are often condemned when their not coming up should be attributed to this cause.

THE EGG-PLANT OR GUINEA SQUASH (*Solanum melongena*).

Although this vegetable often carries badly, shipments are annually increasing, particularly from Florida. It is also becoming more popular

at the North. Notwithstanding it had been in the market from Florida since January, shipments of my own sold in New York at $6 per barrel, containing 65 fruit. In the south of Florida egg-plants and tomatoes may be grown at any time of the year. At Clear Water both mature in December. The only variety grown for market is the New York Improved Purple.

Being a tropical plant, requiring 65° to 70° for germination, it must be sown alone, under glass, in hot-beds. Only on the warmest soil will cold frames suffice. About the middle of January is a good time to sow in hot-bed. The management under glass is the same as with other tender plants, except that the egg-plant requires more warmth than any others.

This plant will endure drought better than any other culinary vegetable, and the sandiest part of the farm may be allotted to it, if the soil has a sufficiency of vegetable matter. In wet soil the fruit, or, more properly, berries, will not mature. It may be manured and grown in hills 2½ by 4 feet apart or in the drill. Earth should be slightly drawn to the stems during cultivation.

To cut the tough stems a pair of strong nippers is the best instrument. They should be allowed nearly to attain full growth, but still be of a dark, glossy purple color before being cut, as small fruit are not desired, and ought to weigh from 1 to 3 pounds. They should be carefully handled, so that the gloss may not be injured, each wrapped separately in paper, and closely packed in crates, or double-headed, well-ventilated barrels only.

The writer first reported to the Department the two following insects as depredating upon the egg-plant: (1) The False Colorado Potato-beetle (*Doryphora juncta*), and (2) the Tortoise-beetle (*Cassida texana*). The former is sometimes damaging, but being readily seen may be picked off.

KALE, BORECOLE, OR SPROUTS (*Brassica oleracea*, var. *sabellica*).

Kale is only grown at Norfolk for the Northern markets. It is the hardiest of the brassica family, could be grown with safety, but the price it commands is no inducement to cultivate it, the earliest ever hardly exceeding $2.25 per barrel.

The varieties used are the Green Curled Scotch and a local one, the Blue Curled, the latter by far the most extensively. Being a member of the same family it requires the same treatment as cabbage in every respect.

The latter variety is sown from August 10 to September 15 in drills 30 inches apart, the plants being ultimately thinned to a stand of from 4 to 8 inches, requiring 1½ pounds of seed to the acre. The Scotch Curled is sown in seed-beds early in August and transplanted at from 8 to 10 inches in the row. The crop is shipped tightly packed in well-ventilated barrels during March.

The same insects infect kale that damage cabbage at the same locality.

LETTUCE (*Lactuca sativa*).

Owing to the poor and wilted condition which transportation involves, this is another vegetable not shipped from the extreme South, nor to any great extent from Norfolk, it being grown in large quantities in hot-beds near Boston for the New York market.

The varieties used at Norfolk are the White Cabbage and the Boston Market or Tennis Ball, the former in open field, the latter under glass.

The seed is sown of both under glass in September. The stand under glass is 5 to 6 inches each way, and in the open field 8 inches in the row, with the lines 18 inches apart.

The crop under glass is marketed during February and March, the other in April, both in crates exclusively.

Any well-drained, rich, mellow soil will produce good lettuce.

It enjoys great freedom from insect depredations.

THE ONION (*Allium cepa*).

A few only of the many varieties of the onion are grown for market.

It had long been erroneously held that the onion could not be grown at the South from seed. I was probably the first, in 1860, to prove otherwise.

The aim of the truck farmer should be to get his crop into market when it is most bare of the same article from other sections. With this vegetable it is difficult to do so. The first spring crop comes from Bermuda from seed grown in the Canary Islands of the Madeira onion. The next, other than from the extreme South, is the Potato onion, grown at Norfolk from sets. About June 15 the supply from Bermuda is generally nearly exhausted, and the Southern crops should then be sent to market.

The best varieties are the foreign Madeira, the small White Queen, and Giant Rocca. No seed but of the previous crop should be used. The onion, being very hardy, may be sown at any time during the fall, but those put in about January 1 will escape the usually inclement weather of December, and will come in early enough.

The best soil is a deep, rich, friable mold, such as is frequently found in river bottoms. Such turf meadow land near Chester, N. Y., produces from 800 to 1,400 bushels of the common Wethersfield onion. The onion crop is one of the most difficult ones to keep clean, and, if possible, newly-cleared land, free of grass and weed seed, should be selected, but whatever the land may be it should be thoroughly prepared and be clear of lumps. Hog manure is generally considered the best for this crop. If stable manure is used it should not be mixed too much with coarse litter to prevent its being plowed under shallow. Fermented manure is best on account of not having so many live seed mixed with it. The land having been manured broadcast with at least forty loads of good manure or its equivalent of fertilizer, it should be plowed in narrow lands of 15 to 20 feet, the water-furrows to act as auxiliary drains. After being thoroughly fined the seed are drilled in 15 inches apart, and in fair weather will be up in two weeks, when the stirring should commence at once. Indeed without thorough cultivation and hand-weeding there is no chance of success in onion growing at the South, where the growth of grass and weeds is so troublesome. At least four hoeings, the push or Dutch hoe being preferable, will be necessary.

They should be thinned to 3 or 4 inches in the row, the White Queen not requiring as severe thinning as other varieties, they being the surest of any to bulb properly. As transplanted onions take root very readily vacant spaces may be supplied, the roots of the young plants being first cut back to a length of about 1 inch.

The crop being wanted for immediate use and not for storing, the onions are to be pulled as they successively indicate maturity by toppling over. After being left on the ground to dry for a couple of days the necks are cut off an inch or so from the bulb and the onions carefully packed in bushel crates.

Onions range from $1 to $2.50 per bushel crate. The crop, however, if properly grown and of the large varieties, may reach 800 bushels or more.

The onion produces seed the second year, and, if carefully saved from well-shaped bulbs, Southern-grown is as good as any. The seed-stalks of some of the large foreign varieties are 5 feet high and need to be supported. The seed is ripe enough for gathering when the pods commence to burst open. The stalks are then carefully cut over a pail or open bag to avoid waste of a part of the seed, and when more fully ripened thrashed out. At Norfolk onions are not grown for market from the seed. Sets of the Potato onion are put out in August and September and those of the Silver skin and Yellow Danvers in February.

There is no known remedy against the two insects which infest the onion. They penetrate the bulb in the ground, and the first indication of their presence is the death of the plant.

THE PEA (*Pisum sativum*).

In consequence of the number of laborers required to pick the crop peas are generally only planted near the cities, bringing in there the first proceeds of the season.

The Early Alpha (wrinkled), the Philadelphia Extra Early, and the Daniel O'Rourke are the favorite early varieties, and the Black Eyed and White Marrowfat the favorite large late varieties generally planted.

A plant so hardy as the pea may be grown in Florida at any time in winter. It is planted in the latitude of Savannah about November 20, following a little later with the early varieties, but about December 1 is early enough, and it is best to make the plantings at intervals of a few days. Only when the pea is in bloom or pod is it likely to be hurt by any degree of cold usual in this latitude.

For the early varieties especially the soil should be warm and dry, a light sandy loam being the best for all. The wrinkled sorts are particularly apt not to come up in moist and cold soil. Good stable manure applied in the drill at the rate of twenty-five to thirty loads is the best. The seed is sown in double drills 10 inches apart on ridges 4½ to 6 feet, and in the drills an inch to 1½ inches apart, according to varieties, either by hand or a seed drill, which puts in both parallel drills at the same time and about 1½ inches deep.

During cultivation of the pea the soil should be hoed up to the stems.

All but the smallest dwarf varieties bear better when they are "bushed" or "stuck," which is done as soon as they commence to run or form clasping tendrils. The cost of sticking peas near Savannah is from $3 to $5 per acre. It is not done near Norfolk.

The early varieties admit of about five pickings, the later one or two more, yielding from 150 to 200 crates per acre, and selling at from $1.50 to $5.00 per bushel crate.

No pods should be picked while yet flat, and none should be packed which are discolored or rough from overripeness.

The crates should be thoroughly shaken down and be overfull when nailed up.

The two weevils, *Bruchus pisi* and *B. granarius*, are only injurious to the seed.

THE POTATO (*Solanum tuberosum*).

Of all the crops of the truck farmer the potato is most extensively grown, as well near the cities as at distant points.

A variety to be suited to the truck farmer should be productive at the

South of large, even-sized tubers, growing close together in the hill, with few unmarketable small ones; it should be early and command the best market price. At present the Early Rose is still the favorite, though not as pure as formerly, with Beauty of Hebron, Early Sunrise, and Burbank as second choice. The potato grown in Bermuda is principally the Chili Red.

It has been found in late years that home-grown seed of the second crop, which is planted near the end of July to August 10, produces the most satisfactory crops, and truck farmers now generally try to secure their own seed, partly at least. The eyes, not being so mature, whatever be the number on the set, only a single one will become developed to grow a single stock to each hill.

In an open, warm, sandy soil the sets may be planted soon after being cut; in a cold moist soil, and to be planted early, the cut surfaces should be allowed to dry by having the sets spread out, or they may be dusted with lime or land plaster. From 3 to 4 barrels, according to the size of the potato and the manner of cutting, will be required to plant an acre. Unlike the egg-plant and tomato, members of the same family, it is intolerant of heat and dryness, and should be planted as early as possible. Since at present only early varieties are used in truck farming, February 1 is early enough, or they may appear above ground so soon as to be liable to injury from frosts.

A cool moist soil is best adapted to the potato. Low black molds in river bottoms, if well drained, may yield larger crops, but the tubers will contain too much gluten instead of the proper proportion of starch, the quality will be inferior, and the carrying capacity will become affected. The lighter the soil the more mealy will be the potato.

The manner of manuring has already been mentioned. But it is to be noted that the potato set should not come into contact with green stable-manure, as they will be killed unless the manure be thoroughly wet by rain.

The furrows in which the sets are dropped, cut-side down, preferably, but not necessarily, at a distance of 12 inches, are 3 feet apart. If originally covered by the plow to the proper depth of 6 inches, no subsequent hilling up during cultivation is advisable.

The crop should not be dug until the plants begin to wilt, when the skin will not slip off upon the tuber being pressed with the finger. If dug too early the potatoes will bruise and turn black in transit; nor while digging should they be exposed to the hot sun. If heated they will surely rot. They should, therefore, be barreled as dug on a bright day and promptly removed or shaded. The culling should proceed at the same time, and no cut or bruised potatoes be permitted among those of first quality. They are shipped generally in well-ventilated, double-headed, round-hooped, flour barrels. At Mobile, however, the first are sent to market in bushel crates.

From 60 to 100 barrels is fair crop per acre, and it matures near Savannah about the middle of May.

The price varies from $2 to $6 per barrel.

The insects infesting the potatoes at the South are, (1) the Potato-stalk Borer (*Gortyna nitela*); (2) the Potato-worm (*Sphinx quinquemaculata*); (3) the Potato-stalk Weevil (*Baridius trinotatus*); (4) the Three-lined Leaf-beetle (*Lema trilineata*); (5) the White Grub (*Lachnosterna quercina*); (6) the Clubbed Tortoise beetle (*Deloyala clavata*); (7, 8, 9) the three Blister-beetles already named.

During this past season of 1885 the true Colorado Potato-beetle (*Doryphora 10-lineata*) was for the first time reported near Savannah. crops come in too early, however, for it ever to inflict much injury.

THE RADISH (*Raphanus sativus*).

The radish is rarely cultivated for the Northern markets south of Norfolk in consequence of losing its acceptable crispness by wilting.

The variety used is principally the Long Scarlet Short Top, sown at any time the season admits there from Christmas to the last of February. It delights in a light mellow soil, in which the manure should be deeply plowed under. The field being plowed in narrow lands and well harrowed, the seed are sown broadcast at the rate of 12 pounds to the acre and covered with a light harrow.

The radishes are pulled in March, bunched, and packed tightly in barrels, the leaves being cut off half their length. A barrel holds from 200 to 300 bunches, and sells sometimes as high as $8, but the price generally ranges low. In very warm weather a lump of ice may be placed in the middle of the barrel.

SPINACH (*Spinacia oleracea*).

Spinach is another vegetable whose cultivation is confined to Norfolk, longer transportation wilting and heating it during transit.

The variety used is the American Improved Curled Savoy.

The seed is sown from September 10 to October 15 in drills 30 inches apart, requiring 10 to 12 pounds to the acre. As with all other plants the leaves of which are used it requires very heavy manuring. After applying at planting time a liberal amount of stable manure some of the farmers add in winter a top dressing of a ton of Peruvian guano.

Occasionally spinach pays well, having sold as high as $10 per barrel, but it costs the best farmers $150 per acre to raise it. When the manuring has been very high the rows are made sometimes only 18 inches apart, and the plants are thinned to a stand of from 6 to 8 inches. The crop is marketed in March, packed tightly in ventilated barrels.

THE SQUASH (*Cucurbita verrucosa*).

At the stage of maturity in which the squash is picked for Northern shipments it bears transportation remarkably well, but it never commands high prices and frequently a part of the product remains unsold.

The varieties are the Early White Scallop Bush and the Early Summer Crook-neck." The latter is the superior in quality, but the former is preferred, as it packs and bears transportation better. It is planted in the latitude of Savannah about the last of February to middle of March. This crop requires a light warm soil and liberal manuring. It is usually manured and planted in hills 4 or 5 feet each way. As in the case of the cucumber several sowings should be made to insure a stand of 2 plants to each hill. The cultivation is the same as that of the cucumber.

When ready for market the rind should still be penetrable by the finger-nail, but not as soft and green as usually picked for local southern consumption. The White Scallop variety should be glossy white, instead of having a greenish cast, and have nearly attained full growth, otherwise they would bruise and turn black in transit.

Squashes may be shipped in double-headed barrels or in crates, but must be carefully packed in either.

The insects infesting the squash-plant at the South are, besides the striped-bug already named, (1) the Twelve-spotted Squash-beetle (*Diabrotica 12-punctata*); (2) the Squash-bug (*Anasa tristis*); (3) the

Squash Vine-borer (*Ægeria cucurbitæ*) : (4) the Melon-worm (*Phacellura hyalinitalis*), and (5) the Squash Lady-bird (*Coccinella borealis*).

The greater injury is done by the two diabroticæ, injuring the seed in the ground, and by the Squash Lady-bird. The latter is readily discovered and may be picked off and killed.

The Tomato (*Lycopersicum esculentum*).

Until tomatoes became so extensively grown in Florida, coming into market so early in the season, this was perhaps the most profitable crop grown. When properly produced, carefully and judiciously handled, it is sure to carry safely during a fair season. The farm gardeners on Long Island rarely get more than from 25 cents to $1 per bushel basket. Formerly Savannah-grown frequently sold for $8 and $10 in Baltimore and Boston. Of recent years $4 is the highest price obtained. The yield is from 100 to 200 crates per acre. The season of picking being of longer duration at the North and the stand closer, the yield is 400 bushels.

A good market variety should be of bright red color, round and smooth, with few seeds, must be firm, and ripen evenly. The Acme and the Mayflower are at present the favorite varieties. A very large variety, like the Trophy, is not wanted.

With the exception of the egg-plant this vegetable resists drought better than any other. A light sandy soil produces finer, firmer, better carrying fruit than a heavy one. If the soil be wet or badly drained, the plants are apt to die before maturing fruit. Indeed, when manured on high ground with fresh muck the fruit is liable to rot. It is a plant which does not require heavy manuring. If well decayed, a shovelful of manure to the hill on fair soil will suffice.

Slow growth being desirable in order that stocky plants may be produced, the seed should be sown under glass on unmanured soil as early as Christmas. If later, the soil may be enriched a little so that plants of good size be obtained. The management of plants under glass has already been alluded to. No crowding should be permitted. Plants thinned out may be "picked out" or "spotted" into cold frames, or slightly-warmed hot beds, 4 or 5 inches apart, where they will have room for stocky growth. If every other row of seedlings, the rows having been 3 or 4 inches apart, are pulled, there will be space left for the remaining to fill out and for hilling them up to encourage the growth of roots from the covered stem, facilitating growth when ultimately put out.

Having grown plants of proper sizes and endurance or hardiness, they should be transferred to the open ground as soon as the season may permit (in the latter part of March, at Savannah). A strong stocky plant will better endure cold and be invulnerable to injury by cut-worms.

On light sandy land the distance apart may be 3½ by 4½ or 5 feet, while on a rich sandy loam, well manured, 3½ by 7 or even more may be necessary. In cultivating this crop it is well to earth up to the stem to encourage the issuing of new roots.

The distance from market or the delay of transportation will determine the degree of ripeness at which the fruit should be picked in order that it may be fully ripe and of proper color upon arrival in market. At Savannah it should just be commencing to show a yellow cast, and further south as soon as it has attained full growth and has about nearly reached that stage of ripeness. Frequently the picking is done

in Florida too early, the shipments arriving at the North still perfectly green and hard. Tomatoes require more careful assorting than any other vegetable—all inferior, bruised, leaky, or worm-eaten ones should be strictly excluded. The trade demands of late years that tomatoes be each wrapped in paper. It protects the remainder of the fruit from leaky or decaying ones. The paper should be soft and strong. Pieces about 7 inches square will answer for medium-sized fruit. The papering involves more careful packing, and, if properly done, there will be no shifting of the contents of the crates. For packing tomatoes bushel crates are generally used, except at Mobile, where they are shipped in one-third bushel crates and peck baskets.

For seed the earliest, well-matured, and best-formed fruit should be selected. When thoroughly ripe they are cut in two and the seed and inner pulp scraped into a pail or barrel and allowed to ferment for several days with frequent stirring. The seed may then be washed from the pulp, dried in sun and air, and preserved in bags. In some seasons the large green worm of *Sphinx carolina* and *Sphinx quinquemaculata* do considerable injury, when they must be hunted and killed, but the most injurious insect is the Cotton-boll Worm or the Corn-seed Worm, *Heliothis armigera*. They rarely touch the leaves, but penetrate the young fruit, one specimen often boring into and destroying several.

THE WATERMELON (*Citrullus vulgaris*).

Melon culture has of recent years been so extensively pursued along the lines of railways in Georgia (mainly), the product has been so enormous, compared with former yields, the stock largely, if not chiefly, of such inferior quality, and the market prices so much below a figure satisfactory to the regular truck farmer, that the latter has abandoned it. The planters now enjoy a monopoly of this crop, and if they were more careful to ship *only* fruit of good quality the return would be more satisfactory and the whole industry more prosperous. No melon of poor quality, faulty shape, or weighing less than 15 pounds should be shipped. The crop has necessarily to be carried in bulk, is subject, therefore, to more or less injury by handling during transit, and every melon should be sound at the time of shipment. Melons should not be planted at distances of miles from the railroads, involving delays in the delivery at the stations and damage in transporting by wagon over rough country roads.

The variety until very recently planted universally, in consequence of its thick rind and good carrying capacity together with large size, was the Rattlesnake. These turned out so poorly last year in size, quality, and endurance, owing to the unfavorably wet season, while the newly introduced Kolb Gem proved better in all these respects, that, at least in the Eastern markets, the latter has displaced the former in popular favor.

Boston and New York are the best Eastern markets, but though the steamers of these lines are capable of carrying large numbers (the New York steamer having taken 70,000 at a trip), the bulk of the crop has to be distributed to the various Western markets by rail, about 1,146,000 having passed over the Western and Atlantic Railroad alone the past season. The Ocean Steamship Company carried 457,687 to New York and Philadelphia; the Boston Line 295,847.

While a yield of 1,000 melons to the acre is not extraordinary, half the number may be considered a fair crop of good shipping melons, such only as should be marketed.

The soil best adapted to the watermelon is light warm sand or very andy loam, and, if newly cleared or having not been planted for three ears, so much the better. Whatever tends to compact the soil, whether rainy weather or a deficiency of vegetable matter, is detrimental to the crop.

Melons are usually planted in hills, a couple of plants to each. The and is laid off 10 or 12 feet apart each way, an opening made with the oe at each crossing, the manure incorporated with the soil, and a flat ill a few inches above the general surface made over it for the reception of the seed. Instead of these distances I prefer 6 by 12 feet, leaving a single plant in each, manuring, if possible, in the drill.

Fresh stable manure is objectionable. One or two shovelfuls of decayed stable manure, cow or hog manure, and a couple of handfuls of cotton-seed meal, or other fertilizer is generally applied. In the latitude of Lowndes County, Georgia, March 1 is early enough for the first planting, but several plantings should be made to secure a stand, even before the first appear above ground. Nothing is gained by putting in this crop too early. If the soil be cold the seed will either rot or not come up, or if it does, and if the plants are exposed to cold nights, they will become stunted, never to recover vigor enough to produce fair yields of first quality melons.

The soil between the rows should be kept stirred by the cultivator and, as the length of the vine increases, furrows should be thrown to the ridges, leaving, eventually, the plant on the middle of wide beds, with intervening water-furrows. The vines should never be handled. Watermelons come into market from Florida of rather poor quality about the latter part of May, from Southern Georgia about June 15, and the sea islands near Savannah about July 1.

An experienced picker can recognize at a glance, from its general light and bright appearance, without touching it, whether a melon has reached the proper stage of ripeness to be cut off the vine for shipment. It has reached this stage when the interior first commences to turn red. If fully ripe it will neither bear transportation nor otherwise be in proper state on arrival in market. The less experienced picker must resort to other signs of approaching ripeness, and those appearing on the surface in contact with the soil are the most reliable. If the rind here has hardened so as to be with a little difficulty penetrable by the finger-nail, or when the pores are perceptible to the touch by a slight roughness of the surface, or when the pores can be distinctly seen, the melon may be picked for shipment. The shriveling of the "curl" or ttle tendril on the vine nearest to the fruit is a usual but not certain ign of ripeness. A ripe melon sounds hollow on percussion with the nuckle, but a large unripe one will emit the same resonance in the hot iidday sun. If the "belly" (surface on which it has lain) is yellow or ough or blistered, it is too ripe for shipment. It were better fed to ogs than be shipped at an expense for freight. Pressure upon the ruit to hear the rupture of the flesh within is mere folly for any purose. If intended for shipment the fruit should never be ripe enough o emit the sound, and if for immediate sale it is damaged in value by he pressure and rupture.

The melon plant and the fruit is subject to injury from the larvæ of *Phacellura hyalinitalis*, an insect similar to the Pickle-worm; but, if it as two broods at the South the early one must be very small in number, as I have never known the early crop to be depredated upon, while he insect is more common later in the season.

THE STRAWBERRY (*Fragaria*).

There are three principal points of strawberry culture at the South for the Northern markets, Norfolk, Charleston, and Thomasville, Ga., but many are also grown scatteringly in Florida, the first few arriving from there bringing sometimes as high as $5 per quart in New York.

Some of the most popular varieties at the North are not suitable as market sorts at the South, not being adapted to the climate; but besides its adaptability to the South, a variety should be productive, be of fair size and appearance, and, particularly, be sufficiently firm to endure the delay and rough handling of transportation without injury, so that it may arrive in market in good condition.

The old Wilson's Albany or Wilson, and the Neuman or Charleston are the most reliable and extensively grown.

During mild seasons, with long intervals between frosts, fruit may mature at any time during the winter at the South in the open ground. I have had a fair yield for a few days at Christmas.

The first shipments may be expected from Florida about February 1, from Charleston late in March, bringing from 75 cents to $1, but the price soon drops as the quantity increases to from 30 cents to 50 cents per quart and lower still. The first from North Carolina bring about the same price as the Charleston berries. The immense quantities from Norfolk, commencing about May 10, bring the price down to 35 cents and 25 cents, and frequently still lower.

The best market for strawberries is New York. Fancy prices are not often paid in Baltimore. While in the cooler and better adapted climate of the North crops as high as 11,000 to 14,000 quarts have been creditably reported, it is doubtful whether, under the most favorable conditions of a moist loamy soil, careful preparation, proper cultivation, &c., more than 6,000 quarts could be produced at the South. Three thousand quarts may be considered a good yield in a fair season.

Moisture being indispensable to successful strawberry culture a soil should be selected most capable of supplying that requirement, and indeed a deep, rich loam, made friable with an abundance of decaying vegetable matter is best adapted to this crop. A great drawback to strawberry growing at the South is summer killing of the plants, and this is most likely in a lighter, hotter soil. If stable manure is to be used it should be well rotted. This plant will not stand as heavy manuring as at the North without going to vine at the expense of fruit, and 30 loads per acre will answer on good soil. Good land having yielded a crop of cabbages, well manured, would require no better preparation than a crop of pea-vines sown May 1, plowed under August 1, and planted in strawberries September 1.

The land having been deeply plowed in narrow lands 30 to 40 feet, the best method of planting strawberries on a large scale is in single rows 2½ to 3 feet apart, the plants to stand 18 inches in the rows. This will admit of the use of a cultivator between the lines. Many farmers neglect their strawberry plants after the first crop, and have to renew the planting every season. In working the crop after the strawberries have been gathered such plants as have taken root in the lines may be left, but all others should be removed. The better plan is only to keep the old plants to bear the second crop.

The plants should be put out as early as possible, if a large production is to be expected. September is the safest month, although, if the

her is favorable and good strong plants are available, it may be in August.

an culture, from the time of setting the plants to that of gathering econd crop, is of paramount importance. If the grower is not mined to accomplish this he had better not attempt a strawberry in our weed and grass growing country.

ter the last working and before the plants bloom they and the in- ning space should be mulched, both to keep the fruit clean and the crop may derive the other advantages of the covering. Pine is that usually applied at the South.

awberries as far south as Charleston should not be fully ripe when d for market, and should at all times be handled carefully to avoid ing. It is best to have the berries picked directly into the quart ets in which they are shipped, provided the pickers can be relied , for the least handling the better. These baskets are packed in ate tiers in well-ventilated crates holding 32 baskets, and these ed as far south as Charleston in refrigerators.

e common field crickets are more destructive to the fruit than any insect, but those specially infesting the strawberry plant at the n are, (1) the Strawberry Leaf-roller (*Anchylopera fragariæ*); (2) Strawberry-worm (*Emphytus maculatus*); the Strawberry Crown- (*Analcis fragariæ*); (4) the Strawberry Leaf-beetle (*Colaspis fla-*; and (5) the Flea-like Negro-bug (*Corimelæna pulicaria*).

INDEX.

A.

ration of food, 11.
ltural Chemists' Association, 11.
chemistry, work in, 9.
Colleges and Experiment Stations, 6, 7.
implements, exportation of, 386.
tables of, 387 to 390.
meteorology, 18.
lture, the money value of scientific, 390 to 394.
poration, experiments in, at Ottawa, 135.
, experiments in, 20.
officinalis, 66.
an Forestry Congress, 199.
ipecac, 72.
Ornithologists' Union, 210.
senna, character and uses of, 68.
woods, Centennial exhibit, 34.
uses of, 35.
uis quinquefolia, 84.
of juices from sorghum, 133, 134.
kumys, 119 to 123.
soils, 9, 162, 169, 170.
sis Californica, 73.
Industry, Bureau of, objects and purposes of, 7.
s, diseases of, 7, 8.
domestic, number of, 9.
live, traffic in, 8.
, 85, 86.
ure, station for, 13.
eaf roller, 330.
cab fungus, 81.
74.
um, a National, 198.
a triphylla, 74.
chia serpentaria, 72, 73.
orm, 271.
307.
al fertilization of queen bees, 339.
canadense, 72.
ored locust, 291.
gus, 612.

B.

um of swine plague, 504.
oisoned, as a remedy for locusts, 232, 300, 309.
chemical examination of, 147 to 149.
comparative production, area and value of, 350.
ush or snap, 613.
vanilla, cultivation of, 65, 66.
ture, 211, 333 to 343.
exhibit of methods of, 34.
t injurious to fruit, 338.
4.
T, THOMAS, report on Dark-sided cut-worm by, 274.
lacea, 66.
70.
gration, investigation on, 210.

Birds and insects, interrelation of, 210.
Black-birds feeding on locusts, 311.
knot, growth and cure of, 78, 79.
Blister of peach leaf, 37 to 42.
Botanical Division exhibits at New Orleans, 34.
Botanist, Report of, 63.
Botany, work in Division of, 20.
Bran mixed with arsenic and sugar as a remedy against locusts, 232, 300, 303.
Bronchitis, verminous, 564.
Brood I of Periodical Cicada, 257.
VII of Periodical Cicada, 247, 250.
XXII of Periodical Cicada, 248, 251.
BRUNER, L., report of, on abundance of Rocky Mountain Locust in 1885, 303.
BRYAN, W. J., report on Texas fever, 548.
Buckwheat, comparative production, area and value of, 350, 351.
Bullock's Oriole feeding on locusts, 298.
Bureau of Animal Industry, objects and purposes of, 7.
stations of, 9.
transfer of, to the Department, 9.
Butter and fats, chemical methods of testing, 89, 99.
tests of, 94, 95.
its substitutes, examination of, 95, 96.
chemical tests of, 99.
counterfeit, 28.
crystals, how to separate, 97.
mounting of, 98.
Butterine, chemical tests of, 99.

C.

Cabbage, 615.
white rust of 1885.
California, locusts in, 209, 229, 289, 308.
migratory locust, 229 to 232.
Silk Culture Association, 219.
Development Company, 220.
State Board of Silk Culture, 219, 220.
Calosoma feeding on garden web-worm, 269
Cane-sugar, inverted, in honey, 115.
Carbonatation at Ottawa, 132.
Carbonic dioxide, 119.
Cascara sagrada, 67.
Cassena, 67.
Cassia marilandica, 68.
Catalpa speciosa, Western hardy, 203.
Caterpillars, protective coloration of, 320.
Cattle fever, geographical distribution of Southern, 523.
in Arkansas, 523.
Indian Territory, 525.
Texas, 525.
market prices of, 369.
table of Texas by counties, 550.
showing different breeds of, and number imported during the year, 56
Cauliflower, 616.
Cereal supply of Europe, 402 to 404.
Cereals, aggregate production and value of, 351.
area and crop of the year, 412.
general conclusions from examination of, 150.
investigation of, 10, 133 to 150.
CHAMBERS, V. T., description of *Gracilaria purpuriella* by, 333
Changes in the larval state of Periodical Cicada, 236.
Chemical Division, laboratory exhibit at New Orleans, 34.
publications in 1885, 30.
Chemistry, Division of, work of, 9, 11.
Chenopodium, 85.
Chimney Swallow, 240.
Chinch-bug in Indiana, 318.
Cicada, 233; 234, 240.
Cincinnati Exposition, preparation of exhibit for, 33.

INDEX.

eland Exposition, preparation of exhibit for 33.
er sickness, 84.
. introduction of, 63.
i, 85.
idæ, 86.
us manniparus, 86.
eges, agricultural, 6.
mercial glucose, 114.
missioner's circular relative to pleuro-pneumonia, April, 1885, 529.
replies to, from different counties, 530 to 546.
clusion of Statistician's report, 430.
clusions, general, from experiments at Ottawa, 137, 138.
ps parasitic on locusts, 299.
vention of agriculturists, 6.
CILLETT, D. W., description of larva of *Eccopsis permundana* by, 331.
report on locusts of San Joaquin Valley, Cal., by, 289.
, area and crop of 1885, 407.
chemical examination of, 138, 139.
comparative production, area and value of, 346, 347.
on, area and crop of the year, 412.
production of, 6.
seed as a fertilizer, 594.
estimates for 1884, table of, 354 to 360.
summary for each State, 360 to 363.
s of the farm, table showing estimate of acres and values, 366.
year 1885, 404.
sing of seed, 48.
rfoot, character and uses of, 75.
tals, butter, mounting of, 98.
to separate, 97.
of lard, how to detect, 99.
mber, 617.
NINGHAM, S. P., report of a trip through Texas, 546 to 548.
oms, imports, foreign, 429.
one nozzle, 303.
pus candidus, 85.
leichus sarcoptoides, 93.

D.

ylotænium ægypticum, 75.
y Statistics, International, 427.
-sided cut-worm, 209, 270, 275.
cation with acid albumen, 136.
rtmental reports, 29.
ructive locusts in 1885, 209, 228, 229, 232, 289, 303, 308.
ction of adulteration in honey, 115.
stating locust, 291 to 295.
sis, the pear, 209, 283, 287, 318.
ra, parasitic on locusts, 299, 310.
ases of animals, 7.
ribution of seed, 47, 48.
sion of Chemistry, 9.
Entomology, 207, 212, 213.
Statistics, work of, 14.
ophila bred from pears, 284.

E.

nomic entomology, exhibit of, at New Orleans, 210 to 212.
le pore mushroom, 105.
plant, 617.
sine indica, 75.
ægyptiaca, 75.
mological Division, work of, 12.
publications in 1885, 30.
tism, 88.
oma cuspidata, 75.
Dictyon glutinosum, 71.
oxylon coca, 63.
orbia, 71, 72.
corollata, 71, 72.
ipecacuanha, 72.

Europe, cereal supply of, 402 to 404.
Evergreen Cleora, 327, 328.
Examination of butter and its subsitutes, 95 to 97.
Pasteur's vaccine for *rouget*, 479.
Experiment stations, 6.
Experiments in Alaska, 20.
the manufacture of sugar, 10.
Exports and imports, agricultural, 377 to 380.

F.

Fairy ring champignon, 103.
Farm animals, numbers, 417.
prices, 422.
tables of number on farms, 367 to 369.
value, 419.
crops, average composition of, 158.
prices, 415.
Fences, cost of. 188.
Fertility, on what it depends, 168.
Fibers, profitable production of, 5.
Filature, establishment of, 216, 217.
FITCH, Dr. ASA, natural history of White-pine weevil, 322.
Flaccidity, a disease of silk worms, 221, 222.
Flax, area and product of the year, 417.
Food adulteration, 11.
Foreign medicinal plants, 64.
Forest fires, from locomotives, 203.
tree insects, report on, by Dr. A. S. PACKARD, 319 to 332.
plantation in Kansas, 203.
Forests, distribution of, in the United States, 187, 188.
effect of, on climate, 196.
increase or decrease of, 190.
influence of, on streams, &c., 192.
present area of, in the States and Territories, 186.
Forestry Congress, the American, 199.
Southern, 199.
Division, progress of, during the year, 204 to 206.
investigations during the present year, 186.
new volume of reports on, 184.
publication in 1885, 30.
report of Chief of, 183.
work in Division of, 21.
Fowls, gape disease of, 550.
experiments with, by Dr. WALKER, 551 to 558.
Fruits, &c., profitable production of, 5.
Fumigating with sulphur for locusts, 300.
Fungi, 94.
Fungous diseases of plants, 76 to 85.

G.

Garden and Grounds, work in Division of, 16.
web-worm, 209, 265 to 270.
General notes on butter, fats, &c., 100.
Genitalia in Diptera, classificatory value of, 287.
Geometrid larvæ, protective resemblance in, 320.
Gillenia stipulacea; 69.
trifoliata, 68.
Glucose, commercial, 114.
estimation of water in, 116.
Glycyrrhiza glabra, 65.
Gooseberry blight, 81.
Government encouragement of wheat culture in India, 580.
Grain sphenophorus, 315, 316.
GRANT, M. R., on poisoning garden web-worm, 269.
Grape-vine mildew, 84.
Grape-vines, true cause of failure in growing, 35, 36, 37.
Grasserie, a disease of silk worms, 221.
Grasses, notes on, 74.
Grindelia robusta, 70.
Ground available for field work too limited, 33.
Gum plant, character and uses of, 70, 71.

H.

amelaceæ, 69, 70.
amelis, 69.
virginica, 69.
palus feeding on garden web-worm, 269.
SER, Rev. I. L., report by, on wheat culture in India, 569.
, comparative production and value of, 352.
gehog, or spine-mushroom, 103.
tory *Eccopsis*, 330, 331.
ey, adulteration of, how detected, 115.
and its adulterations, 109.
data of work on, 117.
description of samples, 110.
estimation of water in, 116.
outline of method in examining, 117.
ey-dew, 85, 86.
eys, analytical table of adulterated, 111.
remarks on tables, 112, 113.
beds and cold frames, 600.
ridization of seeds, 48.
rophyllaceæ, 71.

I.

cassine, 67.
dahoon, 67.
paraguayensis, 67.
lements, agricultural, 384.
orted Elm-leaf beetle, Bulletin No. 6 on, 213.
a, wheat culture in, 569.
area and population of, 581.
an millet, character and uses of, 75.
physic, character and uses of, 68, 69.
turnip, character and uses of, 74.
ticide machinery and contrivances for destroying insects, collection of, 3
substances, collection of, 33.
ts affecting fall wheat, 311.
forest trees, 319.
and birds, interrelations of, 210.
injurious to agriculture, collection of, 33.
rnational Statistical Institute, organization of, 346.
oduced insect pests, preventing spread of, 209.
rted cane sugar in honey, 115.
stigation of cereals, 10.
ac, American, character and uses of, 72.
wild, character and uses of, 71, 72.
ation in India, 580.
ma, 311.

J.

rsonia Diphylla, 66, 67.
son grass, poisonous, reports upon, in Montana, 74, 75.

K.

, Borecole or Sprouts, 618.
sene emulsion for Dark-sided cut-worm, 272.
Locusts, 300.
effect of, on Periodical Cicada, 244.
BELE, ALBERT, report on locusts at and about Folsom, Cal., 308.
ys, 115.
method of analysis, 119.
table of analyses, 120, 121, 122.

L.

es' Silk Culture Society of California, 219.
brownness of the pear, 82.
her-beetle, 209, 258 to 264.
lopterous larvæ, mode of feeding in, 320.
r locust, 233, 303, 306.

Lettnce mold, 84.
Licorice, culture of, 65.
Liquidambar styraciflua, 70.
Liver fungus mushroom, 107.
Live stock in foreign countries, 424 to 426.
Lizard feeding upon locusts, 298.
Local agricultural societies, 6.
Locust, Ash-colored, 291, 292, 293.
California Migrating, 209, 229, 291, 308.
Devastating, 209, 229, 291, 308.
Differential, 233, 293, 295.
Lesser, 233, 303, 306.
Red-legged, 233, 303.
Rocky Mountain, 228, 303, 306.
Yellow, 296.
Locust injnry in 1885, 209, 228, 289, 303, 308.
Locusts in California, 209, 229, 232, 289, 292, 297, 299, 300, 302, 308 to 311.
the Eastern States, 232.
Northwest, 303 to 307.

M.

MAILLOT, Professor, on examination of silk-worm cocoons for *pébrine*, 224.
Maize, production of, 6.
Maple sugar industry, 185.
Marsh-mallow root, culture and uses of, 66.
MCLAIN, N. W., report on experiments in apiculture, 333.
Medicinal plants, introduction and cultivation of, 19.
of foreign, 63, 64.
native, 66.
Melanoplus, 230, 231, 232, 233, 303, 304, 306, 307.
Method of analysis of kumys, 119.
outline of, in examining honey, 117.
Microlepidopterous larvae, mode of feeding in, 320.
Microscopical Division, exhibit of drawings, 34.
work of, 27.
MIK, Dr. Jos., on *Cecidomyia nigra*, 287.
Mildew of clover, 84.
white, 81.
Mildews and blights, 35.
Miscellaneous insects, chapter on, 228.
publications in 1885, 30, 31.
Mite on locusts, 299.
Montana Reservation, 204.
Morthiera mespili, 82.
Mulberry trees, distribution of, 214.
Muscardine, a disease of silk-worms, 221.
Mushrooms, 102 to 107.

N.

Native medicinal plants, 66.
New Orleans Exposition, exhibit of economic entomology at, 212.
Nitrogen and carbon in various soils, tables of, 167, 168.
sources of for crops, 166.
NIXON, JACOB, on remedy for garden web-worm, 270.
Non-migratory locusts, 232.
Notes on grasses, 74.
Notodontian larvae, protective resemblance in, 320.
Nozzles, 303.

O.

Oats, area and crop of 1885, 411.
chemical examination of, 144, 147.
comparative production, area, and value of, 349.
OEMLER, Dr. A., report on truck farming, 583.
Oidium, 81.
leucoconium, 81.
tuckeri, 81.
Oleomargarine, chemical tests of, 99.
Onion, 619.
Onion fly, 274.

n, cultivation of, 64.
ge-milk mushroom, 102.
hology, economic, 210.
promotion of economic, 13.
va experiments, report of the, 123 to 138.
tables of diffusion at, 126, 130, 131.

P.

ARD, Dr. A. S., report on forest-tree insects, 319.
um sanguinale, 75.
rer somniferum, 64.
sites in domestic fowls, 92.
EUR, L., on detecting presence of flaccidity in chrysalides of silk-worm, 222.
ur's vaccine for *rouget*, an examination of, 479.
520.
l-leaf blister and yellows, 37 to 42.
Diplosis, 283.
tree blight, causes and remedies, 42 to 45.
scab, 81.
cracking, causes and remedies, 42 to 45.
ne, a disease of silk-worms, 215, 221 to 225.
gree stock, value of, 424.
dical Cicada, 210, 213, 233 to 256.
oriaceæ, 80.
ospora, 77, 84.
effusa, 85.
gangliformis, 84.
infestans, 83.
nivea, 84.
parasitica, 84.
schleideniana, 84.
sparsa, 84.
trifoliorum, 84.
viticola, 78, 84.
osporeæ, 83, 84, 85.
ian bark, description of, 65.
n pratense, 87.
i, 80.
oxera, 279.
galls inhabited by *Anthonomus*, 278.
bthora infestans, 83.
morbia, 327, 329.
iceæ, 73.
lice, 85.
s, cross and self fertilization of, 51.
fungous diseases of, 76 to 85.
under glass, 33.
gaster, parasytic on pear midge larvæ, 285.
-pneumonia, action taken in regard to, 431
in Delaware, 470.
Illinois, 468.
Kansas, 467.
Kentucky, 431.
Maryland, 472.
New Jersey, 472.
Ohio, 468.
Pennsylvania, 472.
Virginia and West Virginia, 469.
inoculation for, by State authorities and others, 476.
investigations in reference to, in Tennessee, 438.
Texas, 439.
letter of Governor Knott in relation to, 432.
notion in regard to, in Missouri, 463.
opinion of the Attorney-General on the law for extirpating, 461.
outbreak of, in Missouri, 452.
progress of, in Missouri, 458.
recent developments in regard to, in Kentucky, 444.
report of the State board of Missouri in reference to, 464.

Pleuro pneumonia, rules and regulations for the co-operation with States for the pression of, 449.
summary in regard to, 473.
Poisoned bait as a remedy for locusts, 232, 300, 309.
Pollen of seed, 49, 50.
Pomological exhibit at New Orleans, 35.
POPENOE, Prof. E. A., account of *Eurycreon rantalis*, 268.
Potato rot, 45, 46, 83.
causes and remedies, 45, 46.
Potatoes, comparative production, area and value of, 351, 352.
crop of the world, 376.
1885, 412.
Priononyx atrata, 298 to 311.
Production of new varieties of wheat, 52.
by Professor BLOUNT, 53.
Protective resemblance and coloration in *Lepidopterous* larvæ, 320.
Publications by the Department in 1885, 29 to 31.
Puff-ball mushroom, 106.
Purple willow Gracilaria, 332, 333.
Pyrethrum, effect of, on locusts, 291.
Periodical Cicada, 243.

Q.

Quack grass, 88.
Quarantine of United States neat cattle, 565.
stations, Coopersburg and Chester, Pa., 566.
Garfield, N. J., near New York, 565.
Patapsco, near Baltimore, Md., 566.
San Francisco, Cal., 566.
Waltham and Littleton, Mass., 565.
table showing number of cattle at, 566.

R.

Radish, 622.
Railroads, gross and net earnings of, 401, 402.
Rainfall and temperature, 405.
of the wheat area in India, 570.
Ramularia tulasnei, 82.
Red gum, character and uses of, 70,
legged locust, 233, 303.
Report of the Botanist, 63.
Bureau of Animal Industry, 431.
Chemist, 109.
Chief of Seed Division, 47.
Commissioner, 5.
Entomological Division, 207.
Forestry Division, 183.
Microscopist, 89.
Ottawa experiments, 123.
Statistician, 345.
Superintendent of Garden and Grounds, 33.
on agriculture, 333.
Dark-sided cut-worm, 273, 274.
forest-tree insects, 319.
insects affecting fall wheat, 311.
Locusts in California, 289, 308.
the Northwest, 303.
Strawberry weevil, 277.
Truck farming, by Dr. OEMLER, 583.
Rhamnus californicus, 68.
cathartious, 68.
purshianas, 67.
Rheumatism root, character and uses of, 66, 67.
Rheum officinale, 65.
Rhubarb, culture of, 65.
Rhus lobata, 71.
Rocky Mountain Locust, 209, 228, 229, 294, 303, 306, 307.
Rœstelia, 79, 80
Rose rot, 84.

; of the potato, causes and remedies, 45, 46, 83.
iget, investigation of, 516.
les and regulations for co-operation with States for the suppression of pleuro
ıonia, 449.
e, chemical examination of, 149, 150.
comparative production, area, and value of, 349.

S.

nt Augustine grass, 75.
ı Joaquin Valley, California, locusts in, 289.
José nozzle, 303.
r's description of *Anthonomus musculus* and *A. signatus*, 280.
HMIDBERGER'S account of *Cecidomyia nigra*, 286.
ed changing, 58.
crossing or hybridization, 48.
Division, Report of Chief of, 47.
work in, 25.
improvement of, 48.
by selection and cultivation, 54, 55.
nomenclature of, 59.
pollen, 49.
saving, 50.
substances affecting the germination of, 58.
eds, amount appropriated for the purchase and distribution of, 47.
complaints as to distribution of, 48.
differences in, of the same plant, 54.
distributed annually, 47.
germination of, 57.
interchange of, with foreign countries, 48.
methods of distribution of, 60.
object of distribution, 47.
proper method of distributing, 47.
tabular statement of distribution of, in 1884–'85, 61.
vitality of, 56.
f-fertilization of plants, 51.
rell's automatic silk-reel, 208, 209, 218.
ıria glaucia, 88.
k culture, exhibit of at Exposition, 34.
in the United States, 207 to 209, 214 to 219, 221, 223, 227.
work in Division of, 13.
ınk cabbage, character of, 74.
ITH, J. B., report on Dark-sided cut-worm, 273.
Strawberry weevil, 277.
ıt of timothy, 87.
Indian corn, 88.
ieties, local agriculture, 6.
l, acquired or temporary fertility of, 160.
analysis, objects, and interpretation of, 170.
of, in India, 569.
analyses, 151.
apparatus used for mechanical analysis of, 161.
barrenness of, 158.
care necessary in obtaining sample of, 162.
chemical properties of, 161.
composition of the, 152.
denudation of, 153.
difference between, and subsoil, 152.
effect of sand in, 161.
fertility of, depends on climatic conditions, 157.
formation of, 153.
how tilled in India, 571.
improvement of, 160.
mechanical analysis of, 160.
objection to mechanical analysis of, 161.
on derivation and formation of, 151.
power of retaining moisture in, 157.
quantity of, swept away, 154.
temperature of, 157.
weight of, per acre, 168.

Soils, absorbent and retentive powers of, 155.
absorption of ammoniacal salts by, 156.
analysis of, 9.
air dried, tables of, 174 to 176.
questions answered by, 169.
chemical composition of, 162 to 166.
formed by the different geological formations, 153.
from Alexandria, La., 181.
Berrien County, Michigan, 177.
Boone County, Indiana, 178.
Oswego, N. Y., 179.
Rapides Parish, Louisiana, 180.
Walla Walla, Wash., 177.
general classification of, 152.
conclusions in regard to, 156.
fertility of, 154.
geological character and distribution of, 171, 172, 173.
classification of, 152.
history of, analyzed, 173.
importance of a proper mechanical condition, 155.
permanent fertility of, 159.
physical properties of, 154.
prairie, from Dakota, 177.
Table of Rothamsted analysis, 167.
showing the specific gravity of, 169.
Tables of nitrogen and carbon in various, 168.
variations in the texture of, 155.
Soluble matter and water in canes, 135.
Sorghum halapense, 74.
Sorghum juices, analysis of, 133, 134.
seed, improvement of, 55.
sugar exhibited at New Orleans, 34.
experiments with at Ottawa, 123 to 126.
tables of diffusion of, 126, 130.
Southern Forestry Congress, 199.
Sparrow, California, feeding on locusts, 298.
English, *vs.* Cicada, 238.
Spinach, 622.
Spruce-bud caterpillar, 321.
worm, 325, 326.
Plume-moth, 326.
Therina, 328.
Squash, 622.
State experiment stations, 7.
Statistical Division, diagrams exhibited, 34.
publications in 1885, 29.
Statistician, report of, 345.
Statistics, work in Division of, 14.
Stenotaphrum americanum, 75.
Strawberry, 626.
Crown-miner, 278.
Root-worm, 278.
Weevil, 209, 276 to 281.
Sucrose (cane-sugar), 115.
detection of in honey, 115.
Sugar, experiments in the manufacture of, 10.
industry, development of, 5.
Sweet-gum, character and uses of, 70.
Swine breeding in America, 370 to 372.
plague, bacterium of, 504.
conclusion of investigations concerning the cause of, 486.
report on, 521.
disease as observed in swine, 513.
general résumé of investigations concerning, 509.
investigations in, 476.
other investigations of, 516.
results of latest investigations in, 511.
Symplocarpus fœtidus, 74.
Syrphidæ, monograph on, by Dr. S. W. WILLISTON, 213.

T.

s Nos. 1, 2, 3, 4, 5 of analyses of various honeys, 111.
of diffusion experiments at Ottawa, 126, 130.
remarks on, 112.
na flies attacking locusts, 310.
parasitic on *Eurycreon rantalis*, 269.
ished plant-bug, 317.
)erature and rainfall, 405.
table of, 406.
of wheat area in India, 570.
: *viburnana*, 332.
: of butter and other fats, 94, 95.
ile fibers, structure and examination of, 89, 90, 91.
)er and lands, suspension of sale of, 204.
thieves on public lands, 204.
thy, smut of, 87.
cco, comparative production, area, and value of, 352, 353.
ito, 623.
ir, 321, 325, 326, 329.
sportation rates, 394 to 401.
planting by railroad companies, 200 to 202.
extent and success of, 196 to 198.
seed, distribution of, 198.
on the Western plains, 184.
rotropis, 296, 297, 307.
um repens, 88.
gh used for catching locusts, 300.
: farming, by A. OEMLER, 583.
causes of failure in, 608.
green manure for, 597.
labor in, 585.
locations of, 585.
manure and its application, 590.
packing and marketing for, 602.
profits of, 607.
seed for, 605.
soil and preparation, 587.
shipped, amount of, 610.
leaf, character and uses of, 66, 67.

U.

ula, 81.
spiralis, 84.
go panici glauci, 88.
salvcii, 87.
Zeæ Mays, 79, 88.

V.

per acre of farm products, 365, 366.
quarterly amount of products, 366.
la beans, cultivation of, 65, 66.
'a *planifolia*, 65.
gated *Eccopsis*, 331.
ıia creeper, 84.
snake-root, character and uses of, 72.
ty of seeds, 56.
:ked *Cacœcia*, 329, 330.

W.

s of farm labor, 380 to 384.
, vacuum pan, 135.
s preying upon locusts, 298.
waters from cells at Ottawa, 131.
melon, 624.
economy in the production of, 334.
ER, F. M., report on insects affecting fall wheat, 311.
worm. (See Garden web-worm).
t of ordinary crops, table of, 158, 159.
soil per acre, 168.

Wheat, acreage of in India, 574, 575.
area and crop of 1885, 409.
chemical examination of, 140 to 144.
comparative production, area, and value of, 348.
cultivation of, in India, 573.
cost of, in India, 573.
culture in India, by Rev. I. L. HAUSER, 569.
distribution of, 372.
effect of product on price of, 374.
export of, from India, 576.
increase of yield, 375.
insects, 311, 315, 316, 317, 318.
prices of, in India, 577.
production and exportation of, 374.
of new varieties of, 52.
by Professor BLOUNT, 53.
reaping and thrashing in India, 572.
soaking seed, 79.
transportation of, in India, 576.
varieties of, in India, 579.
weight by bushel of different varieties, 143.
winter, area and crop of the year, 414.
White grub, 316.
-heart hickory *Gelechia*, 331, 332.
pine weevil, 322 to 325.
rust of cabbage, 85.
the strawberry, 82.
Wild ginger, character and uses of, 72, 73.
ipecac, character and uses of, 71, 72.
senna, character and uses of, 68.
turnip, character and uses of, 74.
Willow *Teras*, 332.
Wintering bees, 335.
Witch hazel, character and uses of, 69.
Wood, consumption of, for railroad ties, 185.
exports and imports of, 189.
manufactures of, 190.
Woods and wood products, exhibition of, at New Orleans, 183.
Wool industry, 28.
Work under the direction of assistant chemists, 138 to 182.

Y.

Yaupon, 67.
Yellows in peach trees, cause of, 37 to 42.
Yellow locust, 296.
Yerba mansa, 73.
santa, 71.
Yield per acre of farm products, tables of, 364, 365.

Z.

Zerene catenaria, 327.

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